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SUBJECTS: Formulae and Insect Pests.

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H. A. Surface, M. S., *Economic Zoologist, Editor.*

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A PROSPECT OR FORWARD VIEW.

The term of four years for the present Economic Zoologist has come to an end, and he has been reappointed for a second term of the same duration. What this office has accomplished in the past our readers should already know. What it may accomplish in the near future depends upon us alone, but to a great extent upon the immediate and faithful co-operation of interested persons. We have no promise to make, beside that an endeavor to perform faithfully all duties that may be possible within the scope of this office. For successful results it is not only necessary that the work be done but that this reach the people who need help.

As a means of extending needed help to the public our Monthly Bulletin will be continued unless the burden should become too great to be carried. Certain lines of experimentation and investigation will be continued and the results will be published in the Bulletin. Inspections of orchards and nurseries will be continued and demonstrations of the methods of fighting all kinds of diseases and enemies of plants will be given whenever possible. If persons should wish demonstrations of the methods of spraying for any insect pest or disease of plants, they should make application either to this office or to the inspector and demonstrator in their respective districts. The State furnishes the apparatus and material without charge, and only asks the aid of the person who is to receive the direct benefits of the demonstration.

One new feature that will probably be undertaken will be to select an orchard of fair size in the central part of each fruit-growing district of the State and give it such treatment during the entire year as it may need to suppress the pests, and produce first class fruit. Nothing will be of greater benefit in drawing the attention of the public to the real benefits of caring for trees.

Our investigations of the enemies of insects will be continued, and Bulletins will be published upon these subjects. The mailing list will not be revised at this time, but the Bulletins will be continued to the persons who are now receiving them, and other names will be added, without charge, as they are received at this office. Specimens of insects, reptiles, etc., are requested, and reports of impending insect outbreaks are desired promptly. We make an earnest request for the help of the public in the service, which must be imperfect without it. All personal requests will be answered promptly and Bulletins mailed as near the first of the month for which they are dated as may be done in consideration of the great amount of work that is placed upon the State Printer.

Address all packages and communications to

H. A. SURFACE,
Harrisburg, Pa.

CALENDAR FOR 1907.

By H. A. Surface, State Zoologist.

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CALENDAR FOR 1907.

FOR TREATING INSECT PESTS AND PLANT DISEASES.

PART I. FORMULAE AND METHODS.

I. A. FUNGICIDES, FOR PREVENTING DISEASES OF PLANTS.

A fungicide is a preparation for preventing diseases of plants. As most of these diseases are due to fungi, these materials are consequently called fungicides. The following formulæ are not insecticides and should be used only for diseases, for which they are recommended, and not for insects. Many of them can be made to act as both fungicides and insecticides by the addition of the proper material (See I. C., "Combined Insecticides and Fungicides.")

1. Ammoniacal Solution of Copper Carbonate, or Cupram.

This fungicide is used in place of the Bordeaux Mixture when there is objection to the latter staining the fruit, flower or foliage.

Formula: Copper Carbonate, 5 ounces; Ammonia (26° Beaumé), 3 pints; water, 45 gallons.

Dissolve the Copper Carbonate in the ammonia. This may be kept any length of time in a closed bottle, and diluted to the required strength when ready for use. It loses strength when standing open. It leaves no stain or color.

2. Bordeaux Mixture.

Make a stock solution of Copper Sulphate by suspending the Copper Sulphate (Blue Vitrol) in a bag just below the surface of a vessel of water, or dissolve it in hot water, at the rate of one pound to a gallon of water. Do not put it in a metal vessel. Make also a stock solution of lime; use a quantity of good lime, slake slowly, and add water to make a thick milk of lime; allow to cool before using, and always keep the lime covered with water.

The operator should either use fresh lime and slake it with water and thus obtain the calcium hydrate, or make a stock of lime paste by slaking the lime dry in the ordinary manner, and at once add enough water to cover it. Keep it in a barrel or vat in the form of paste or putty. Dip this out and use it in regular proportions at any time, being careful that it is kept covered with water to exclude air. Air-slaked lime can not be used in any of the following formulae where the lime is to enter into a liquid, unless twice as much be taken as would be required in using the water-slaked.

(a) For dormant trees use: Copper Sulphate, 6 pounds; Lime, 6 pounds; water, 50 gallons.

(b) For most plants in foliage use: Copper Sulphate, 4 pounds; Lime, 4 or 5 pounds; water, 50 gallons.

(c) For delicate plants use: Copper Sulphate, 3 pounds; Lime, 6 pounds; water, 50 gallons.

If the lime be of good quality and the mixture be made as directed, there will be no burning of the foliage. However, it is always best to determine whether enough lime has been used by testing the mixture. Spray with it, but do not sprinkle.

"There are three simple tests which may be used. (1) Hold a clean, bright knife blade in the Bordeaux Mixture for at least one minute. If it become copper-plated more lime should be used. (2) Pour some of the Bordeaux Mixture into a shallow dish and, holding it up to the light, blow gently across its surface. If properly made a thin pellicle will form on the surface of the liquid. If this does not form more lime should be added. (3) Dissolve one ounce of ferro-cyanide of potassium in 5 or 6 ounces of water. Pour some of the Bordeaux Mixture into a white dish and add to it a few drops of the ferro-cyanide solution. If sufficient lime has been used no change will be noticed. If a brownish-red discoloration takes place more lime should be added."

3. Soda Bordeaux Mixture.

Copper Sulphate, 4 pounds; Commercial Caustic Soda or Soda Lye (sodium hydroxid), slightly, about 1 pound and 5 ounces by test-alkaline—according to strength, about 1 pound and 5 ounces by testing; water to make 50 gallons.

To use instead of ammoniacal copper carbonate, to act as a fungicide and leave no stain.

Warning.—In each case of change of grade or brand of commercial caustic soda it will be necessary to test the strength with litmus paper to keep a slight excess of soda or lye, as shown by turning red litmus blue. Keep the mixture well agitated.

4. Copper Sulphate—(Blue Vitrol or Blue Stone).

A solution of Copper Sulphate is used as a preventive of grain smuts. (See also Formalin, Corrosive Sublimate.) It may also be used as a spray in place of the Bordeaux Mixture.

(a) For dormant trees use: Copper Sulphate, 1 pound; water, 25 gallons.

(b) For trees in foliage use: Copper Sulphate, 1 pound; water, 250 gallons. (Not as desirable as Bordeaux).

(c) For oat or wheat smut:

Soak the seed 10 to 12 hours in a solution of one pound of Copper Sulphate to 25 gallons of water. Then put the seed for 5 or

10 minutes into lime water, made by slaking one pound lime and diluting to 10 gallons with water. The lime tends to prevent the Copper Sulphate from injuring the seed.

(d) For killing Mustard in oat fields in spring, spray when the Mustard is only a few inches tall with 10 pounds dissolved in 40 gallons water. (It is not recommended for all kinds of weeds).

5. Corrosive Sublimate.

Corrosive Sublimate is deadly poison to all animal life, and therefore care must be taken to prevent animals from eating the materials treated. It is used against potato scab and grain smuts. (See also Formalin).

For use dissolve two ounces of corrosive sublimate in two gallons of hot water; then dilute to 15 gallons; allow to stand 5 or 6 hours, agitating several times meanwhile. (Always use wooden or earthen vessels; never metallic).

(a) For Potato Scab.—Place the seed potatoes in a sack and immerse in this solution for 1 or two hours. Plant them before they become contaminated with stray spores of the scab that may be found on dirty floors of the barn, etc.

(b) For Smuts of Oats, Barley and Wheat.—The seed may either be soaked, as for potatoes "seed" or may be sprayed thoroughly with the solution. In either case the seed must not be kept wet long enough to heat. Oats should be enclosed in sacks so they can be immersed in the liquid, as otherwise they float.

6. Formalin.

This has been found to be the best remedy for potato scab and smuts.

(a) For Potato Scab.—Soak the seed potatoes for two hours in a solution of a one-half pint of formalin to 15 gallons of water.

(b) For Grain Smuts—Soak the seed one to two hours in a solution of 1 pound of formalin to 50 gallons of water, or pour or spray the liquid over the seed while shoveling it over on a floor to mix it. Put oats into sacks to immerse.

(c) For Onion Smut and Black Rot of Cabbage.—Soak the seed for one to two hours in a solution of one-half ounce Formalin to 1 gallon of water, then plant in uncontaminated soil.

7. Iron Sulphate and Sulphuric Acid.

Formula: Hot water, 100 parts; iron sulphate, as much as will dissolve; commercial sulphuric acid, 1 part.

Add the acid to the crystals and then pour on the water. This is a good fungicide for dormant grape vines attacked with anthracnose. Apply with sponge or brush.

8. Potassium Sulfid.

A stock solution is made as follows:

(a) Formula: Potash, 32 pounds; sulphur, finely ground, 37 pounds; salt, 2 pounds; water, 50 gallons.

The potash, sulphur and salt may be mixed together in a large metal tub with a little water; the chemical action will make it boil. For spraying on foliage dilute with 100 times as much water. It is used against the active stages of the red spider. Three applications at intervals of one week kills the eggs and moulting forms.

(b) A solution, which loses strength upon standing, is made by mixing one half to one ounce potassium sulfid (Liver of Sulphur) in one gallon of water. It is used against mildews of gooseberry, rose, carnations, violets, grapes, etc.

9. Dust Spray.

Sulphate of Copper, Powdered (Dry), 1 pound; Finely divided Dust, such as Slaked Lime or Flour, 20 pounds; Dust this over the plants when the leaves are moist, as with dew, or after a rain. When they are moist with dew in the evening or in the morning is a good time. (See No. 61).

10. Lime-sulphur Formula (No. 41). All preparations given of Lime sulphur Formulæ are first class fungicides, especially for Peach-leaf Curl when applied before the buds burst.

11. Sulphur and Lime.

Powdered Sulphur, 1 part; Lime, 20 to 40 parts.

Mixed in the soil in hills or furrows where cabbage is to be set to prevent Club Root, and where Sweet Potato plants are set this mixture is said to prevent Sweet Potato Rot.

12. Cut and Burn Diseased Parts.

Some plant diseases can not be met by any other means known at present than by cutting out and burning the diseased parts. Among these are Pear Blight, Twig Blight, and related diseases which are thought by many to be identical. Burn at once all trees with Peach Yellows, cabbage with Black Rot, etc.

Promptness in destroying diseased plants or parts of plants is essential in preventing the spread of disease, not only in the first year of its occurrence, but especially during the following year.

I. B. INSECTICIDES, FOR KILLING INSECTS.

Internal Insecticides, for Poisoning Chewing Insects.

13. Paris Green.

Arsenical insecticides are used to combat the various insects that chew the foliage and fruit. Although there are better arsenical in-

secticides, Paris Green is the most popular. Even the Paris Green from the best manufacturers contains at times a great deal of uncombined arsenic. Therefore, it is to be expected that some persons get better results from its use than others. Some will have the foliage burned very badly and others not at all. There is no reason why Paris Green should not be as effective as it was a few years ago, excepting that it is now often adulterated. In one of the neighboring States a great many samples of Paris Green were analyzed, and none that were purchased from the manufacturers were found adulterated, while several from dealers were so adulterated and diluted as to be ineffective when used according to standard formulæ.

To make a liquid spray of Paris Green, slake the lime gradually and sprinkle in the Paris Green, then add the rest of the water; or stir the Paris Green into the paste with enough water to make it pasty or mushy, in a smaller vessel, and then rinse it into the larger vessel containing the water. Always use at least twice as much lime as Paris Green in order to destroy the evil effects of the free acid that would burn the foliage.

(a) Strong Formula: Paris Green, 1 pound; Water, 75 to 100 gallons.

This is for very hardy plants, such as potatoes, and for insects that are especially hard to kill, such as Canker Worms.

(b) Medium or Ordinary Formula.

Paris Green, 1 pound; Fresh lime, 2 pounds; Water, 150 gallons:

This is the formula most generally used for nearly all plants, but for the tender kinds, it should be yet more dilute.

(c) Dilute formula for tender plants.

Paris Green, 1 pound; Fresh Lime, 2 to 4 pounds; Water, 200 to 300 gallons.

This is for such plants as the tender varieties of plums, like the Japanese, and also for peach, apricot, etc. It is not necessary to apply this or any other insecticide excepting when insects are present, or are likely to appear soon. There have never been any ascertained cases of persons being poisoned by the use of fruits or vegetables sprayed with arsenites, although it would not be best to spray shortly before picking or gathering the crop.

14. London Purple.

This is a common arsenical insecticide, although not used as much as formerly. It is a waste product in aniline dye manufacture. It is cheaper than Paris Green and is held in suspension in water longer, but the composition is very variable and more of the arsenic is in a soluble form than in Paris Green, therefore it is more dangerous to foliage, and is not highly recommended.

When used with three or four times as much lime it will be safe, and can be used in practically the same proportions as Paris Green.

15. White Arsenic.

Owing to the great amount of free acid which White Arsenic contains it can not be used alone upon foliage plants, but it is a valuable poison when mixed with flour or powdered sugar, or both, for certain insects like cockroaches, or for sprinkling on slices of potatoes for making poison bait traps.

White Arsenic, 1 part; flour, 20 parts; powdered sugar, 20 parts.

16. Arsenate of Lead or Disparene.

This is the least soluble of all the arsenical insecticides, and is, therefore, not liable to burn the foliage, even if used in large proportions. It is also quite adhesive, and is about the only arsenical poison that will stick to smooth plants without the addition of something to make it adhere.

Formula: Dissolve 11 ounces acetate of lead (sugar of lead) in 4 quarts of water in a wooden pail, and 4 ounces arsenate of soda (50 per cent. purity) in 2 quarts of water in another wooden pail. (The sugar of lead can be dissolved more quickly by using warm water.)

If only a small quantity of the arsenate of lead is required it can be purchased in the prepared paste or dust form, and 3 pounds used 50 gallons water.

The above solutions poured into 150 gallons of water are required for Codling Moth, Tent Caterpillars, etc.; while these solutions poured into only 25 gallons of water are required for the Elm Leaf Beetle.

Arsenate of lead may be used whenever Paris Green is recommended. Its trade name is "Disparene."

17. Arsenite of Lime.

Formula: White Arsenic, 1 pound; Freshly burned lime, 2 pounds; water, 1 gallon.

Boil together for 45 minutes. Keep the resulting product in a tight vessel.

One quart of this added to a barrel of water or Bordeaux Mixture is used against biting insects. However, in Oregon, especially, it very often burns the foliage.

18. Arsenite of Soda.

(Known as "Kedzie" formula).

Boil 2 pounds of white arsenic and 8 pounds of sal soda for fifteen minutes in 2 gallons of rain water. Put this in a jug and label "Poison." When ready to spray slake 2 pounds of lime and stir it into 40 gallons of water, adding a pint of the mixture from the jug.

The arsenic in a pint of this mixture is equivalent to 4 ounces of Paris Green, and may be used whenever Paris Green is recommended. This insecticide is used in preference to Arsenite of Lime, because in the Arsenite of Soda one is sure of all the arsenic being combined to become insoluble in water, and thus there is no danger of burning the foliage. Arsenite of Lime is cheaper ,but Arsenite of Soda is more reliable.

19. Green Arsenoid and Green Arsenite.

These insecticides are applied in the same manner as Paris Green. They contain no free acid, and are thus not so liable to burn the foliage. They cost less than Paris Green (12c to 15c per pound), and being finer remain in suspension longer. Dr. Marlatt, of the Division of Entomology, U. S. Department of Agriculture, says Green Arsenoid should replace Paris Green as an insecticide.

Avoid Paragrene, Scheele's Green, White Arsenoid (Barium Arsenite), and "Bug Death." All but the last named contain so much soluble acid as to injure the foliage, and the last is reported as worthless by experiment stations that have tested it, and our own experiments indicate the same.

20. Poison Traps.

(a) Fresh Baits. These are prepared by dipping slices of potatoes, apples, or bunches of damp or wet clover into solutions of arsenical poisons, or dusting them while wet with arsenical poisons and placing them around the plants to be protected, as for Climbing Cutworms, or just beneath the surface of the soil around the plants, as for Common Cutworms and Wire Worms, or beneath boards in gardens where Cutworms and Wire Worms occur.

(b) Bran mash.

Arsenic Formula: White Arsenic, 1 pound; Brown Sugar, 1 to 2 pounds; Bran, 6 to 10 pounds.

Mix thoroughly and then add water to make a wet, but not sloppy mash. Other arsenites can be used if White Arsenic be not obtainable. Increase the proportion of the poison according to the kind used.

It is used against Cutworms working in garden crops, at the rate of one teaspoonful at the base of each plant. It is also recommended to be put at evening in rows of corn where Cutworms and Wire-worms are likely to be numerous. With tender plants care should be taken lest heavy rains wash the poison against the stems and thus burn the plants.

(c) Criddle Mixture.

This mixture has met with great success in Manitoba as a remedy against grasshoppers.

Formula: Paris Green, 1 part; Salt, 2 parts; Horse manure, 100 parts (by measure).

Mix the Paris Green with the water; mix this through the horse manure and then add enough water to make a soft but not sloppy mash. If the horse manure be fresh the addition of the salt is not necessary. Use as the Bran Mash, i. e., simply scatter the mixture over the land where the "hoppers" are thickest. It is most effective when spread in hot, sunny weather.

(d) For Household Pests.

Borax, white arsenic, powdered sugar and flour, equal parts are recommended for cockroaches, and a small quantity of white arsenic baked with cake dough makes a very good "home-made" rat biscuit, which has been known to be successful. This should be guarded with care from being used accidentally as food.

21. Borax.

For cockroaches spread powdered borax on bread, sweet potatoes or banana peelings, or mix with sweetened chocolate and place the bait where the roaches can get it. See Turpentine, etc. Use borax freely about sink, wainscoting, etc.

22. Plaster of Paris.

Plaster of Paris, 1 part; Powdered Sugar, 1 or 2 parts.

This has been used as an internal insecticide for cockroaches especially. The insects are said to eat the mixture, which will form an insoluble and indigestible mass in their digestive tracts and thus kill them. It is also said to kill mice and rats, but we have not been able to give it a test before this writing.

23. Hellebore.

This is an internal poison for insects, but not for man. It is used in place of Paris Green in the case of cauliflower or cabbage when there is danger of poison remaining on the part to be eaten. Hellebore is not poisonous to man, and so can be handled with impunity.

For Currant Worms—Sprinkle the dry hellebore on the leaves, on the under side when possible, when the dew is on, or after the leaves have been sprinkled with water, to insure its sticking.

Hellebore may be made into a decoction by using 1 ounce in from 1 to 3 gallons of water and applying it as a spray to poison insects where arsenites would be objectionable, as upon leaves to be eaten or on ripening fruits, and especially upon currants and gooseberries.

One part can be mixed with 5 to 10 parts of a cheap grade of flour and kept over night in a closed vessel, when all will be equally efficient as a powder.

CONTACT APPLICATIONS FOR KILLING SUCKING INSECTS.

The contact insecticides are chiefly for the suctorial insects, because these can not eat the internal poisons and consequently can not be killed by them, although the insecticides mentioned in this group will also kill most biting and chewing insects with which they come in contact. It is necessary for the contact insecticide to touch the insect, and if the latter be so protected, as by growing leaves or otherwise, that it is not touched by the application, the same does no good. For this reason it becomes necessary to apply such materials early before the leaves become large, abundant or deformed.

24. Kerosene.

Pure kerosene if properly applied may be used on pear trees in winter without great danger to the trees, but 40 per cent. kerosene is almost as destructive to insects, and may be used on apple and pear trees in winter without danger. Under no circumstances, however, is pure kerosene recommended to be used on active plant life of any kind. It has been used undiluted on plants dormant and in foliage (apple, pear and others) without apparent injury, but there are too many uncertainties attending its use to warrant its recommendation.

For pure sprays always purchase the 150 degree fire test kerosene.

For Cockroaches and other Household Pests.—With an atomizer spray into the cracks, etc., where the roaches are located.

For Mosquitoes.—Kill the larvae or wrigglers in water by putting one teaspoonful of kerosene on each square yard of water area.

25. Kerosene Emulsion.

This, probably, is the best form into which kerosene can be put in order to obtain the best results. When the kerosene is in an emulsion the proportion of kerosene is known to a certainty, while with the Kero-water sprays the proportion is not always just what one expects.

A stock emulsion is made as follows:

(a) Soap Emulsion.

Hard soap, shaved fine one-half pound; Kerosene, 2 gallons; Water, 1 gallon.

Dissolve the soap in boiling water; remove from the stove and add the kerosene while the water is still boiling hot; churn with a spray-pump until it gets to a soft, butter-like mass. Keep this for a stock mass.

For plant Lice and young scale insects use 1 part of the stock to 10 parts of water. Some insects will require a much stronger mixture.

(b) Milk Emulsion.

Plate I. Root Worm of Cabbage and Radish. (*Pnorbia brassicæ*), infesting Radish. Photographed in the office of the Economic Zoologist, from specimens collected near Harrisburg, Pa.
(See *Monthly Bulletin*, Vol. IV, p. 394.)

Plate II. Field infested with Root Worm (*Phorbia brassicæ*), showing Cabbage and Cauliflower, untreated. Many of the plants apparently vigorous died after the photo was made. By D. K. McMillan of the office of the Economic Zoologist.

Plate III. Cabbage field, once in the same condition as that shown in Plate II, and photographed at the same time. Treated with Carbolic Emulsion and saved. Showing the results of our experiments.
(See *Monthly Bulletin*, Vol. IV, p. 387.)

When small quantities of emulsion are wanted it is often less trouble to make it with milk than with the soap and water.

Sour Milk, 1 gallon; Kerosene, 2 gallons.

Dilute as in preceding. If the milk be sweet add a little vinegar.

(c) Kerosene Emulsion with Pyrethrum, Sulphur, etc.

The insecticidal value of Kerosene Emulsion made by either of the above formulæ is increased by the addition of Pyrethrum, Hellebore, Tobacco, Sulphur, or any other powdered contact insecticide. It is particularly more valuable against Red Mites or Spiders when an ounce of powdered sulphur is added to each gallon of the material used as a spray.

26. Kerosene Mixture.

By using a Kero-Water Spray Pump or other spray pump made for the purpose of mixing kerosene and water at the time of spraying, a very good substitute for Kerosene Emulsion is obtained with no further trouble than to place the kerosene in one vessel and water with which it is to be mixed in another. It is to be applied according to one of the two general formulæ, as follows:

(a) Strong, for dormant trees.

Apple and pear will not be injured with Kerosene Mixture as strong as 50 per cent., while plum is likely to be injured if it be stronger than 40 per cent., and peach, even though dormant, with more than 20 per cent. Thirty-five per cent. Kerosene Mixture is about the weakest that will kill the scale during the dormant season.

(b) Dilute, for plants in leaf:

Kerosene, 1 part; Water, 10 parts.

This will not injure the foliage of any fruit trees or garden plants if properly applied, but is as strong as should be given to peach. All injuries by oils will decrease by spraying upon a bright and windy day when the evaporation is hastened.

Experiments seem to indicate that, like crude petroleum, the safest time to apply is on a bright, windy day in early spring, just before the buds begin to swell, in the form of a very fine spray.

One part of kerosene to six parts of water can be used on many trees in foliage without injury, while plant lice are killed in a mixture as weak as 1 part of kerosene to 15 or 20 parts of water. For plant lice, therefore, 1 part of kerosene to 10 of water is probably the best proportion to use. This proportion will also kill young scales, and is a good summer spray for San José Scale, but must be repeated often.

27. Benzine, Gasolene and Turpentine.

These substances are used singly and undilute, as contact insecticides, where pests are not on green leaves or plants that would be injured.

2

They are especially valuable to spray or inject into cracks inhabited by cockroaches, bed bugs, flea larvæ, carpet beetles, etc., and will kill all insects with which they come into contact, which injure carpets, clothes, or other fabrics. To kill ants find their nest and pour one of these substances into it in abundance.

We have examined an insecticide sold in this State and recommended to kill household pests of all kinds, scale insects, etc., and have found it to be nothing but benzine colored pink with a red vegetable extract, such as juice from red cabbage or beets.

28. Carbolic Soap.

Soft Soap, 2 pounds; Rain water, to thin like paint; Carbolic Acid (crude), 1 ounce. Apply to the bark of trees, twigs, etc., but not on the leaves.

There is a commercial carbolic soap that is not so strong, and is recommended for scrubbing pet animals and live stock for parasites, such as lice, fleas, etc.

29. Carbon Bisulphide, or Bisulphide of Carbon.

(a) For Insects in the Air.

This substance is used against a number of insects, and also other animals, which cannot be combatted with internal or even contact poisons. This liquid volatilizes very rapidly, and the gas being heavier than air, must be generated from above. It is used with good success against ants, buffalo or carpet beetles, clothes moths, museum pests, grain insects, woodchucks, prairie dogs, etc.

For the Buffalo Beetle.—A very strong percentage of the Carbon Bisulphide must be used to enable the fumes to penetrate into the body of the rugs, carpets, etc., where the insects are.

For Insects in Stored Grain.—Use one pound of Carbon Bisulphide to each 1,000 cubic ft. open space, or 100 bu. grain. Place the liquid in a shallow dish on the top of the grain; close the bin tightly and leave for twenty-four hours.

CAUTION: Keep lights of all kinds away where using.

For Borers in Trees—Inject a few drops of this liquid into their holes, and plug them with mud, putty, or grafting wax.

(b) For Insects in the Soil.

For Ants—First find the ant hill, then with a cane make several holes ten to twelve inches deep, into each of which pour 3 to 5 tablespoonfuls of Carbon Bisulphide. Cover the ant hill with an old blanket or burlap, preferably moist, to keep in the fumes, and leave twenty-four hours. Sometimes more than one treatment is necessary.

For Pests on the Roots of Plants, Grasses, etc.—Make holes in the soil to the depth of the pests and pour one or two tablespoonfuls of Carbon Bisulphide into each and close it at once by packing damp

earth into it with the foot. In loose sandy or loamy soil make three holes in each square yard, and in compact or "heavy" clay soil make four.

Where the gas is to rise through the air, as in fumigating nursery stock or dwelling houses, Hydrocyanic Acid Gas is to be preferred.

30. Corrosive Sublimate, for Insects.

Corrosive Sublimate is deadly poison to all animal life, and therefore care must be taken to prevent animals from eating the materials treated. It is used against potato scab and grain smuts. (See also Formalin).

For Bedbugs—A mixture of Corrosive Sublimate, one ounce; Alcohol, one-half pint; Turpentine, one-fourth pint, sprayed in all cracks and crevices where bugs might lodge, will effectually rid a house of the pests. More than one dose will probably be necessary. This is a good contact poison and also repellant.

31. Creolin.

Commercial Creolin is a blackish brown liquid, costing about twenty-five cents a pint. This is highly recommended for dog fleas, which sometimes become very annoying pests in dwelling houses. As the cat and dog are the source of the pest, these animals must be rid of the insects. The animals should be washed thoroughly with a mixture of creolin and water. For dogs a three per cent. solution should be used, or nearly four tablespoonfuls to a gallon of water; for cats a two per cent. solution, or about two tablespoonfuls of creolin to a gallon of water. Get the creolin well mixed with the water before using.

32. Crude Petroleum.

(a) Strong, for dormant plants.

"Crude Petroleum is an oily, inflammable liquid, varying in color from very dark brown to greenish tints. By refining it yields a number of valuable products, including paraffin, lubricating and illuminating oils and a series of highly volatile oils. It is the heavier oils that make it especially valuable as an insecticide. Crude Petroleum varies in appearance and composition according to the locality from which it is taken. The eastern oils are said to vary greatly from the western and most foreign oils, the former having a paraffin and the latter an asphalt base. The true indication of the safety of petroleum as an insecticide evidently depends upon its specific gravity; as it has been found that petroleum having a specific gravity of 43 degrees or above (Baumé oil scale at a temperature of 60 degrees F.) is less likely to injure the trees than petroleum, of a lower specific gravity, although oils of a lower specific gravity have been success-

fully used in some instances, notably in Canada." (N. Y. State Bul. 202, 1901.)

This is one of the best scale insect remedies. It should be applied on a bright, sunny day in early spring, and must be applied thoroughly and evenly; avoid over-drenching.

On perfectly dormant apple trees a 40 per cent. emulsion is used; on perfectly dormant plum trees a 25 per cent. emulsion is used, and on dormant peach trees not over 20 per cent; and on dormant pear trees 100 per cent., or undiluted Crude Petroleum can be used successfully for Scale Insects, without injury to the trees.

(b) Dilute, for plants in leaf.

Crude Petroleum or "Rock Oil" can be diluted by making into an emulsion or by applying as a mixture with water by using apparatus made for mixing. Use the same percentages and methods as in emulsifying or mixing kerosene or refined lamp oil.

It is not necessary to select oil of a certain known specific gravity if it is to be applied dilute. Crude Petroleum can not be used in making the Kerosene-Lime Mixture (No. 45), as it forms masses that will not pass through the nozzle.

33. Fish Oil.

Fish Oil is really the basis in the manufacture of Whale Oil Soap instead of Whale Oil for the useful insecticide that bears its name. It is also valuable in killing parasites on domestic animals by rubbing them with it. It is also the basis of a valuable repellant for keeping flies from horses and cattle, which is made as follows:

Fish Oil, 100 parts; Oil of Tar, 50 parts; Crude Carbolic Acid, one part.

Mix or shake these well together and apply as a spray or mist by means of a hand spray pump.

34. Carbolic Emulsion.

One pound of hard soap, one gallon of hot or boiling water, one pint crude carbolic acid.

Shave the soap and dissolve in the hot water, pour in the carbolic acid and churn or beat into a creamy emulsion.

Use one part of the emulsion to 30 parts water. It can be applied as a spray for plant lice or poured on ground around plants, using from a few spoonsful to a half pint on each plant.

This formula has been recommended as a remedy for the cabbage root worm, but experiments made recently by this office show that one part of the emulsion in 30 parts of water did not kill the pests unless it came directly in contact with them and remained so for a few minutes. One part in fifteen parts of water was more effective and the plants were apparently uninjured by the emulsion on exam-

ination four days after the application. It did not kill all the larvæ even at this strength. Its greatest merit perhaps lies in its action as a repellant in preventing the flies from laying their eggs. To be effective it should be applied before the larvæ attack the plants.

35. Hydrocyanic Acid Gas.

It is fully recognized that fumigation with hydrocyanic acid gas is one of the best methods of combating scale and other insects. For this reason many large nurseries in the region infested with San José Scale fumigate all their nursery stock before shipment. The laws of some countries require this, while no nursery stock, except evergreens, can be shipped into Canada without first being fumigated with this gas at the port of entry. All nursery stock liable to infestation by San José Scale must be fumigated before being brought into Pennsylvania. The gas is now used in greenhouses, granaries, mills and other buildings subject to infestation by insects or objectionable animals of any kind. The gas is a deadly poison to all animal life and great care must be taken in generating it. Unless thoroughly acquainted with its use, the entomologist or some competent authority should be consulted before handling.

The chemicals used in the production of the gas must be very accurately determined. The formula per 100 cubic feet of space usually used is:

Potassium cyanide (98 per cent.), 25 grammes (about one ounce); Sulphuric acid (1.83 sp. gr.), one-half more acid, liquid measure than cyanide (about two ounces); Water, twice as much water, liquid measure, as acid (about four ounces).

One of our Monthly Bulletins to be issued in the near future will contain a full account of the methods of generating and using Hydrocyanic Acid Gas for various purposes, including nursery stock and also household pests.

36. Lime.

Lime is of little if any value as an insecticide, being simply a deterrent and irritant. It can be used wet or dry on foliage without harm. When dusted on pear slugs or other tree-slugs or the larvæ of Asparagus Beetles it prevents them from doing much damage.

It is used to prevent Sun Scald by making a coating on the body of the tree in early spring. To increase the adhesive power make according to the following formula:

Skim milk, six gallons; Water, thirty gallons; Lime, sixty pounds; Salt, ten pounds. (Can. Expr. Farm Rpt., 1900.)

A path or band of air-slaked lime around a plant bed keeps it free from slugs and snails.

37. Lime-sulphur (California Mixture).

Sulphur (either Flour or Flowers), seventeen pounds; Quick Lime (or Fresh Lime), twenty-two pounds; Water, fifty gallons.

Slake the Lime finely, add Sulphur while slaking; cover with water and boil briskly for an hour. Add water to make fifty gallons and apply as a wash or spray while warm. It is not necessary to use it boiling hot, and the only reason for applying it warm is that it then runs better through the nozzle. (See our previous Bulletins for detailed directions.)

This was formerly made with salt, which is now proven unnecessary.

This certainly is the best and cheapest insecticide to be recommended for Scale Insects, Peach Leaf Curl, etc. It must be used when the trees are dormant, when it will not harm any kind, and can not be applied too strong nor too freely.

This is the cheapest good remedy for the San José Scale, that is known, and as far as we know at present is the best to recommend in extensive orchards.

38. Lime, Sulphur, Blue Stone (Oregon Mixture).

The proportions of the Lime, Sulphur and Blue Stone in this Wash are the same as for the Lime-sulphur-salt Wash in the following: Some persons recommend only one and one-half pounds of Blue Stone, while others recommend several times as much. This mixture is not to be highly recommended for the reason that the fungicidal value is not greatly increased by Blue Stone, as the Lime-sulphur Washes, when properly made, are both insecticides and fungicides without the necessity of adding additional material. It was formerly supposed that the addition of Blue Stone greatly increased the fungicidal value of this wash, but this has not been proven to be true by experiment, while it does unduly increase the expense.

39. Lime-sulphur-soda Wash.

Caustic Soda, five pounds; Flowers of Sulphur, twenty pounds; Quick Lime, twenty-five to thirty pounds; water, fifty gallons.

This is to be recommended as an unboiled Lime-sulphur Wash, and to be effective must be made with great care. For details of the process of making this, see pages 208 and 296 of Volume II of the Monthly Bulletin of the Division of Zoology.

This fully takes the place of the boiled Lime and Sulphur Washes, as it is both fungicidal and insecticidal in action, although it is more expensive when extensively used. It is to be recommended for use on a few trees or in small orchards.

40. Kerosene-Lime.

Kerosene, 1 gallon; Freshly Slaked Lime, 4 pounds; Water, 10 gallons.

This will make a mixture containing 10 per cent. Kerosene. For 20 per cent. Kerosene, as on dormant trees, use one-half the amount of water, and for a 5 per cent. Kerosene and Lime, as for plant lice and young scale insects, use twice the amount of water.

This is practically the mixture that has been advertised considerably as Limoid and Kerosene. The Limoid is a commercial product, and this name is given to a particular brand of magnesium lime from a particular kiln. The Kerosene-Lime has not yet been fully tried for scale insects and other suctorial insects, but we are now experimenting with it, and shall be able within a few weeks to discuss its merits. Its adhesiveness can be increased by the addition of Resin Soap or Resin Lime Mixture.

41. Potassium Sulphide (Liver of Sulphur).

This was mentioned as a fungicide (No. 11), and formula 11a, made with 50 gallons of water, is also a valuable insecticide to use on a few dormant trees for scale insects, etc. It is also recommended as a good insecticide against San José Scale when made as follows:

Potassium Sulphide, 1 pound; Lime, fresh, 1 pound; Water, warm, 2 gallons.

Mix and apply as a spray, or as a wash with a brush, when trees are dormant, or paint on the bark at any time. This is an easily-made substitute for the lime-sulphur washes, but more expensive.

42. Lye, Soda, Caustic Potash, etc.

These are in popular favor, but experiments show them to be of not much use. When trees are dormant one pound of lye to three gallons of water may be used on the limbs of the trees. For trees in foliage, one pound to forty gallons of water, but this will kill only the very tender insects, and stronger than this will burn the foliage.

These substances are valuable to destroy the Peach tree borer when used as follows:

Lye, Caustic Soda or Potash, 1 pound; Hot Water, 20 gallons.

Pour a quart of this mixture, while hot, around the base of each infested peach tree. Stir in any fertilizer that one may wish to add.

43. Pyrethrum.

This is the ground-up flowers of the Pyrethrum plant. It loses strength unless kept in a tight can or jar. When burned in a room it will destroy mosquitoes, flies, fleas, cockroaches, etc. It may be used as a spray, 100 grains of powder to two gallons of water.

44. Resin Soap.

This substance may be used against plant lice and other soft-bodied sucking insects. It may also be used, like the preceding sub-

stance, with Paris Green or Bordeaux, to make these stick to glossy surfaces.

Resin, 2 pounds; Caustic soda, 1 pound; Tallow, 1 pound.

Dissolve the soda in 1½ gallons of water; then add resin and tallow and dissolve them by applying a moderate degree of heat; add water enough to make 3 gallons.

Before using, dilute 1 pint of soap with 16 pints of water. This is a summer wash.

45. Resin Wash.

Resin, 20 pounds; Concentrated lye, 4 pounds; Fish oil, 2½ pints; Water, 100 gallons.

Place the resin, lye and oil in a kettle with sufficient water to cover them to a depth of 3 or 4 inches. Boil about 2 hours, making additions of water, until the compound looks like very black coffee. Dilute to one-third the final bulk with hot water or with cold added slowly over the fire, making a stock solution that must be diluted to 100 gallons when ready for use. This is a winter wash.

46. Salt, Nitrate of Soda, etc.

These are good to use against certain pests, such as root lice and root "worms." For example, a remedy that has been highly recommended to destroy root maggots of cabbage, cauliflower, etc., is a thimbleful of salt poured on the roots of the growing plants beside the stalk.

47. Soaps.

(a) Ivory or Common Laundry or Soft Soap.

This is quite valuable as a contact insecticide.

Use Ivory soap (10c size), 1 bar; Water, 15 gallons.

Apply warm, as it thickens on cooling. It is recommended for Rose Mildew, "Red Spider," Plant Lice, Mealy Bugs on household plants, etc.

(b) Whale Oil Soap.

This is good in combatting scale insects in family orchards or in old commercial orchards. It is too expensive, however, for general use.

For the winter spraying of scales use:

Two pounds of the soap to each gallon of boiling water.

This is doubtless the best insecticide to be used as a paint or wash applied upon the bark during the spring and summer. It should be kept from the foliage and young shoots, but will not injure the bark, yet only one application should be made in any one season. All portions of the bark should be covered.

For pear slug use:

One-half pound to 1 gallon of water.

For plant lice use:

One pound to 8 or 10 gallons of water.

This dilute solution may be used either as a spray or as a wash into which the twigs and leaves infested with plant lice and young scale insects may be dipped by bending them over into a pan containing the material.

(c) Tak-a-Nap Soap.

This is a new proprietary soft soap with which one can easily make a very good kerosene emulsion by merely pouring the proper amount of kerosene to make the desired percentage of emulsion into the suds or aqueous solution of the soap and stirring it violently or forcing it around through the pump for a few minutes.

48. Sulphur.

(a) Dry, for pests on leaves:

Sulphur, 1 part; Flour or slaked lime, about 9 parts.

Apply as a dust, especially when the leaves are damp, for mites, slugs, currant worms, etc.

(b) In Liquid.

Sulphur, 1 ounce; Water or soap solution, 1 gallon.

Apply as a spray for mites or "red spiders," and some other pests on house plants.

49. Tobacco.

This is a very important contact insecticide. In the form of a fine dust it is excellent for bearing trees affected with root lice; two-thirds inch of surface of earth is taken away from around the tree and 1½ to 2 pounds of dust is evenly scattered over the surface and afterwards covered with earth. The first application should be made in June, and if necessary repeated in August. It may also be used in the form of dry stems against root lice by applying it in the same way as the dust.

As a decoction of the leaves or stems it may be used as a spray against plant lice; or first spray with water and then sprinkle with the dust. Use tobacco leaves or stems, 1 pound; water, 2 gallons, steep or boil. Its efficiency is increased by adding one ounce of pyrethrum.

The decoction is also good to kill lice on cattle.

Tobacco smoke, when generated in an enclosed space, is fairly successful in combatting plant lice, as in greenhouses.

50. Water.

(a) Warm.

Warm water may be used as an insecticide, as in soaking peas and beans in tepid water for a few hours before planting them to kill the infesting weevils.

(b) Hot.

Hot water, or steam, may be valuable in certain cases. One of the best means of treating house plants for the numerous pests that infest them is to hold them in steam of a teakettle a few inches from the spout, where it is as hot as the hand can be held.

Plant lice dipped in hot water are killed at once. Into a wash boiler of water as hot as the hand can bear dip infested house plants for a few minutes. Nearly all kinds of insects upon them will soon be killed, and with a little experience the operator will learn the greatest length of time that each variety can safely be submerged in water of a certain temperature.

Hot water is also used in killing Clothes Moths and other household insects in clothing that can be submerged in it.

One of the best means of treating Carpet Beetles is to spread a damp towel over the carpet at the spot where it is infested and by ironing this with a hot flat-iron drive the steam down through the carpet and thus kill the pests.

51. (a) Hand-picking.

Where insects are large enough to be seen plainly and can be reached without difficulty it is often advisable to destroy them by picking by hand, as with tomato worms, grape vine leaf-beetles, stinking squash bugs, tent-caterpillars, eggs of canker worms on small trees, etc.

(b) Jarring.

For insects that are difficult to treat by other means and will drop suddenly when disturbed, as the Curculios, there is no better known means of treatment than to place a sheet or blanket under a tree and jar it severely with a few strong raps by a heavy, padded mallet. Then shake the fallen material into a pan of oil on water. A Curculio catcher is made by mounting a sheet on a wheel-barrow.

(c) Shooting.

A standard remedy for such insects as the Tent-caterpillar in many parts of Pennsylvania is to load a muzzle-loading shot gun (no choke bore), with black powder and a paper wad and shoot the nests or tents out of the trees.

(d) Burning.

Fire is a certain and safe means of destroying pests wherever they occur in parts of plants that can be burned. It is much better to sacrifice a stunted and badly-infested plant than to expose others to infestation from its pests. Always burn all parts possible.

(e) Cutting out.

One of the most unsatisfactory means of treating certain pests, such as borers, is to cut them out. This should not be necessary, because proper preventive measures (No. 86) should prevent them

entering the trees or plants. However when necessary to kill or remove borers try Carbon Bisulphide (No. 33) or Benzine (No. 31 a), or insert sharpened pliable wire into the hole and pierce the borer. In cutting, always cut lengthwise, not cross wise to the tree or vine, and cover the injured part with grafting wax to protect it. It is practical to cut borers out of squash vines by cutting lengthwise.

TRAPS.

52. Bands of Cloth, etc.

Certain insects, such as codling moths when preparing to pupate, climbing cutworms, etc., will conceal themselves under cloth or burlap bands placed around trees. Such bands should be put in place to serve as traps, and for codling moth larvæ they should be examined and the pests killed at least once per week.

53. Boards, Corn Cobs, etc., on the Ground.

On lawns and in gardens cutworms, crickets and false army worms, etc., will hide during the day time under boards which may have been placed flat on the ground or grass to attract or trap them. Stinking squash bugs and other pests in the garden can be caught by boards or corn cobs placed on the ground near the plants to be protected. The next morning drop the pests into a can of oil and water. We have trapped many by this means.

54. The Hopper-dozer for Grasshoppers.

The Hopper-dozer is a western invention, shaped something like a long dust-pan, with oil or tar in the pan, to be drawn across fields infested with grasshoppers to trap and kill them. Upon rare occasions we have known certain kinds of grasshoppers to become of sufficient local abundance in Pennsylvania as to demand such a trap.

I. C. COMBINED INSECTICIDES AND FUNGICIDES.

55. Bordeaux Mixture and Paris Green or Other Arsenites.

It is possible by combining Bordeaux Mixture or certain other fungicides with Paris Green or other arsenites to make a combined insecticide and fungicide. It does not really make much difference which fungicide or which arsenite is used, but Bordeaux Mixture with Paris Green added is the most common combination of this kind. Although it is generally not advisable to use such combined mixture upon fruits or crops that are about to be harvested on account of the supposed danger of poisoning them for the consumer. It is so easy to add Paris Green to Bordeaux Mixture and make both an insecticide and fungicide that we advise this whenever Bordeaux

Mixture is applied. On the other hand whenever spraying with Bordeaux Mixture, Paris Green and an excess of lime to equal twice the amount of the arsenite used should be added to the regular Bordeaux formula. We recommend this mixture for the Codling Moth, Leaf Spot, Apple Scab and various leaf-eating insects, applied as a spray shortly after the blossoms fall. Use 4 ounces of Paris Green or 1 gallon of Arsenate of Lead in 50 gallons of Bordeaux, according to the regular formula as though they were being used in water alone.

56. Dust Spray and Paris Green.

To the regular Dust Spray given in Formula 12 add 1 part of Paris Green to 40 parts of the Dust Mixture. Other arsenites can be added in the place of Paris Green if desired and if finely powdered.

I. D. ADHERENTS.

These are neither insecticides nor fungicides. They are simply materials for making insecticides and fungicides stick to smooth plants such as asparagus, cabbage, cale, cauliflower, kohl rabi, turnips, celery and onions. The desired insecticide or fungicide must be added to the adhesive mixture.

57. Resin Lime Mixture.

Pulverized Resin, 5 pounds; Concentrated Lye, 1 pound; Fish Oil or other animal oil, 1 pint; Water, 5 gallons.

Place the oil, resin and one gallon of water in an iron kettle and heat until resin softens. Then add the lye and stir thoroughly. Now add four gallons of hot water, and boil until a little of the mixture when dropped into cold water will mix with it, and give a clear amber colored liquid. Add water to make up for evaporation and make the entire mixture 5 gallons. Keep this as a stock solution, and add two or three gallons to each barrel of liquid spray, whether it be Bordeaux Mixture or Paris Green and water or other liquid. The material known as Bordeaux Resin is nothing more than Bordeaux Mixture made by the regular formula with two gallons of this stock solution added to each barrel.

58. Soap.

Soap is used to make spray liquids adhere to such smooth plants as those mentioned above, adding one pound to from ten to fifty gallons of the spray liquid.

James Good, No. 941, N. Front Street, Philadelphia, Pa., has made, according to a formula advocated by the U. S. Department of Agriculture, an adhesive soap, which can be bought and used with great success for this purpose. It is similar to No. 62.

59. Resin.

Resin alone added to hot water and kerosene in making kerosene emulsion stock greatly increases the adhesiveness of the kerosene emulsion. Use one pound of the Resin to each one gallon of kerosene in making the original stock emulsion before diluting.

60. Syrup or Molasses.

Any cheap grade of molasses added to a spray increases its adhesiveness, and is consequently useful upon smooth plants. Syrup, 1 pint; Liquid Spray Mixture, 5 gallons.

61. Glue.

Glue can be used to make a spray liquid stick by dissolving it in hot water and adding it to the liquid.

Glue, 1 pint or one pound; Liquid Spray Mixture, 5 gallons.

62. Flour.

A cheap grade of flour is useful not only as a carrying agent to convey dust spray or insect powders, but when dusted over damp leaves will also help to hold them upon plants.

Flour, 1 part; Diluted Spray Dust, 12 parts, or Flour, 1 pound; Spray Liquid, 5 gallons.

If the flour be boiled with water and made into a regular flour paste, it will be improved as an adherent in a spray mixture.

63. Salt.

Salt is recommended by many persons to increase the adhesiveness of certain washes, such as Lime-sulphur Washes and also Whitewash. Use one pound to three or five gallons of liquid.

(To be concluded in the June issue.)

SPECIMENS RECEIVED DURING APRIL, 1907.

Number.	Specimens.	Date—April, 1907.	Name and Address.
	Insects.		
8790	Insects,	1	G. R. Pritchard, Harrisburg.
8792	Scurfy Scale,	1	W. L. Campbell, Euclid.
8795	(a) Scurfy Scale,	1	J. K. Yoder, Mattawana.
8797	Scurfy Scale,	1	W. R. Spatz, Mt. Carmel.
8798	(a) Scurfy Scale,	1	I. M. Oglevee, Hanlin Sta.
8800	Scurfy Scale,	1	I. Rhoads, Catawissa.
8802	(a) Scurfy Scale,	1	J. H. Hathrill, Moscow.
8803	Twice-stabbed Lady Beetle (C. bivulnerus).	1	J. F. Heckert, Northumberland.
8804	Moth eggs,	1	Miss. E. Warner, Pineville.
8807	Promethea Cocoon,	2	Miss. E. D. Morton, Ingram.
8808	(a) San José Scale,		
	(b) Rose Scale (A. rosæ),	2	D. Morehart, Montgomery.
8809	San José Scale,	2	E. E. Schaffer, Brick Church.
8811	Wheel Bug eggs (P. cristatus),	2	T. H. Parker, Norristown.
8812	(a) Oyster-shell Scale,	2	O. Lochmann, Newtown Square.
8813	Oleander Scale (A. hederæ),	2	Mrs C. Dunkle, Temple.
8818	(a) Scurfy Scale,	3	S. Swartz, Spring Forge.
8819	Tessellata Scale (Lecaniodiaspis tesselata).	3	Mary M. Haines, Cheltenham.
8823	San José Scale,	3	W. C. Barger, Hollidaysburg.
8825	San José Scale,	3	Lemasters Warehouse Co., Lemasters.
8826	(a) Scurfy Scale,		
	(b) San José Scale,	3	D. Metzger, Linglestown.
8831	(a) Oyster-shell Scale,		
	(b) Scurfy Scale,	4	B. S. Duncan, Ore Hill.
8832	Oyster-shell Scale,	4	J. M. Hammond, Northfort.
8833	(a) San José Scale,		
	(b) Scurfy Scale,	4	A. Berry, Roxborough.
8834	Oyster-shell Scale,	4	D. Schlosser, Erie.
8837	Oyster-shell Scale,	5	A. J. Eberly, Raughts.
8838	Canker Worm Moth and Eggs,	5	D. W. Fisher, New Wilmington.
8844	(a) San José Scale,		
	(b) Scurfy Scale,	8	S. Swartz, Spring Forge.
8845	Oyster-shell Scale.	8	W. A. Brown & Sons, Osceola Mills.
8847	Polyphemus Cocoon,	8	S. E. B. Lingamfelten, Greencastle.
8848	San José Scale,	8	W. Forcey, Beech Creek.
8849	(a) San José Scale,		
	(b) Scurfy Scale,		Dr. J. R. Rodgers, Carlisle.
8851	Cecropia Cocoon,	9	T. A. Gartley, New Castle.
8855	Mealy Bugs,	9	O. S. Gottshalk, Iron Bridge.
8856	Eyed Elater,	9	C. LeFevre, Lisburn.
8859	(a) San José Scale,		
	(b) Pistol-case Bearers,	9	Prof. Beisline, Mechanicsburg.
	(c) Tree-cricket Egg Punctures,		
8860	San José Scale,	9	Rev. J. O. Clippinger, Mechanicsburg.
8861	Tree-cricket Egg Punctures,	10	C. H. Rich, Woolrich.
8865	(a) Cecropia Cocoons,		
	(b) Promethea Cocoons,	11	C. H. Knipe, Marietta.
	(c) Polyphemus Cocoons,		
8866	Oyster-shell Scale,	11	L. Martin, Clarence Centre, N. Y.
8867	Canker Worm Eggs,	11	H. J. Collins, Volant.
8868	(a) Oyster-shell Scale,		
	(b) Scurfy Scale,	11	W. W. Clark, Conneaut Lake.
8874	(a) Oyster-shell Scale,		
	(b) San José Scale,	12	A. D. Hamilton, Penbrook.
8875	Oyster-shell Scale,	12	D. H. Miller, East Orange, N. J.
5578	Cecropia Cocoons,	12	J. E. Patterson, Wilkes-Barre.
8879	Aphis Eggs,	12	G. W. Michaels, Baldmont.
8880	Scolytid Beetles,	13	Dr. I. H. Mayer, Willow Street.
8881	(a) San José Scale,		
	(b) Scurfy Scale,	13	B. F. Merrell, Wilkes-Barre.
8882	Insects,	13	W. C. Dickson, Wayne.
8884	Promethea Cocoons,	15	F. S. Andrews, Wellsboro.
8885	Bagworm Cocoons,	15	W. D. Dixon, St. Thomas.
8887	(a) Scurfy Scale,	15	John Bowman, Pottsville.
8888	(a) San José Scale,		
	(b) Variegated Cutworms Eggs (P. m. saucia).	15	Mrs. J. W. Atkinson, Buckingham.
8889	(a) Tarrapin Scale,	15	J. Hemminger, Carlisle.
	(b) San José Scale,		
8893	San José Scale,	16	D. Light, Cochranville.
8895	(a) Tussock Moth Eggs,		
	(b) Cecropia Cocoon,	16	Mrs. E. Morton, Ingram.
8896	Oyster-shell Scale,	16	C. M. Warner, Lehighton.

Number.	Specimens.	Date—April, 1907.	Name and Address.
8902	Oyster-shell Scale,	17	W. Hughes, Kylertown.
8903	Katydid Eggs,	18	F. M. Bream, Gettysburg.
8905	(a) Scurfy Scale,	18	H. Kerstetter, Liverpool.
8906	Katydid Eggs,	18	R. M. Adams, Lancaster.
8908	(a) Scurfy Scale,	18	E. W. Rarig, Catawissa.
8909	(a) Scurfy Scale,	18	J. Schatzle, Aquashicola.
8910	(c) Bird Louse from Horned Grebe,		
8910	(d) Bird Louse from Reb-breasted Merganser.	19	C. L. Woodcock, Raymond.
8913	Scurfy Scale,	19	A. J. Beltz, Allentown.
8914	(a) San José Scale,	19	R. C. Banes, Wallingford.
8915	San José Scale,	19	A. C. Strode, Reedsville.
8917	Work of Scolytid Eggs,	20	F. C. Haines, Germantown.
8919	Oyster-shell Scale,	22	H. J. Collins, Volant.
8920	Scurfy Scale,	22	A. H. Rothermel, Reading.
8921	Cecropia Cocoon,	22	L. J. Walker, Covington.
8922	(a) Plant Lice,	22	Rakestraw & Pyle, Kennet Square.
8925	(a) San José Scale,		
	(b) Scurfy Scale,	22	B. M. Mixer, Waterford.
8926	(b) Darkling Beetle (H. aereus),	22	J. M. Schenck, Enid.
8927	Cecropia Cocoon,	22	D. M. Stone, Stull.
8928	(a) San José Scale,	22	W. W. Harper, Chestnut Hill.
8929	Katydid Eggs,	22	H. T. Huyett, Shillington.
8930	Scurfy Scale,	22	H. B. Leighty, Newry.
8936	Oyster-shell Scale,	23	J. F. Brubaker, Lebanon.
8937	(a) Oyster-shell Scale,		
	(b) Scurfy Scale,	23	M. Snyder, Fisher's Ferry.
8938	(a) San José Scale,		
	(b) Oyster-shell Scale,	23	W. M. Emerick, Shamokin.
	(c) Lecanium,		
8939	(a) Scavenger Beetle (C. carolina),		
	(b) Cicada larva,	23	N. H. Wilburn, Derry Sta.
8940	(a) Scurfy Scale,	23	E. M. Lydick, Indiana.
8941	Ground Beetle Larva,	23	F. L. Witherup, Emlenton.
8942	(a) San José Scale,		
	(b) Scurfy Scale,	24	E. Welles, Wilkes-Barre.
	(c) Cherry Scale (A. ostreaeformis).		
8945	(a) San José Scale,		
	(b) Scurfy Scale,	24	H. A. Melhuish, Picture Rocks.
	(c) Oyster-shell Scale,		
8946	(a) Oyster-shell Scale,	24	L. T. McCabe, Waverly, N. Y.
8949	Cecropia Cocoon,	25	P. W. White, Cogan Sta.
8951	(b) Assassin Bugs,		
	(c) Roach,	25	W. C. Dickson, Wayne.
8961	White Flies,	26	Miss D. M. Ziegler, Carlisle.
8964	Insects,	26	G. R. Pritchard, Harrisburg.
8965	San José Scale,	26	F. Corss, M. D., Kingston.
8968	Cynip Gall (D. nebulosus),	27	Mrs. J. U. Moore, Transfer.
8969	Cynip Gall (B. cuscutaeformis),	27	H. M. Conser, Sunbury.
8970	Plant Lice,	27	W. N. Flanagan, Columbia.
8974	Oyster-shell Scale,	29	T. B. Roth, Greenville.
8977	(b) Polyphemus Cocoon,	29	J. B. Richard, Barto.
8979	Hemiptera Eggs,	29	G. P. Williams, Waterford.
8981	Diptera Larva,	29	L. L. Springer, Edenville.
8982	Oyster-shell Scale,	29	A. H. Clark, Muncy.
8984	(a) Oyster-shell Scale,	29	D. H. Davis, Tunkhannock.
8985	(a) San José Scale,		
	(b) Katydid Eggs,	29	J. P. W. Craighead, Carlisle.
8992	Bagworm Cocoons,	30	J. D. Moyer, Souderton.
8993	Scurfy Scale,	30	L. Snyder, East Mauch Chunk.
8995	Scurfy Scale,	30	E. S. Shirk, Lebanon.
8996	(a) Oyster-shell Scale,		
	(c) Scurfy Scale,	30	J. W. Steward, Weatherly.
8997	San José Scale,	30	E. L. Myers, Gardenville.
8998	Oyster-shell Scale,	30	C. D. Weed, Waymart.
8999	Oyster-shell Scale,	30	A. Rhoads, Berlin.
9000	Promethea Cocoons,	30	J. S. Campbell, Cheswick.
9001	Oyster-shell Scale,	30	H. J. Miller, Butler.
9002	Oak Scale (C. obscurus),	30	W. W. Long, Washington.
	Invertebrates Not Insects.		
8795	(b) Mites,	1	J. K. Yoder, Mattawana.
8798	(b) Mites,	1	I. M. Oglevee, Hanlin Sta.
8802	Mites,	1	H. J. Hathrill, Moscow.
8805	Snails (Physa heterostropha),	1	J. Couch, Hickory.
8858	Mites,	9	A. B. Thompson, Mercer.
8873	Centipede,	12	Mr. Franklin, Harrisburg.
8887	(b) Mites,	15	J. Bowman, Pottsville.
8888	(c) Garden Spiders,	15	Mrs. J. W. Atkinson, Buckingham.
8909	(b) Mites,	18	J. Schatzle, Aquashicola.
8914	(b) Mites,	19	R. C. Banes, Wallingford.
8928	(b) Mites,	22	W. W. Harper, Chestnut Hill.

Number.	Specimens.	Date—April, 1907.	Name and Address.
8940	(b) Mites,	23	E. M. Lydick, Indiana.
8946	(b) Mites,	24	L. T. McCabe, Waverly, N. Y.
8950	Gordius,	25	H. R. Snyder, West Berwick.
8951	(a) Centipede,	25	W. C. Dickson, Wayne.
8962	(a) Mites,	26	P. H. Peffer, Harmony.
8963	(a) Hermit Crab, (b) Fiddler Crab,	26	Dr. I. Wellls, Harrisburg.
8980	Slug,	29	A. C. Rutter, Perkasie.
8986	Mites,	29	W. Dymond, Orange.
	Reptiles and Batrachians.		
8790	(a) Common Garter Snake (T. sirtalis). (b) Cricket Frog (A. gryllus),	1	R. Pritchard, Harrisburg.
8791	Common Garter Snake,	1	F. S. Andrews, Wellsboro.
8799	Red-bellied Snake (S. occipitomaculata).	1	A. Shaffer, Saylorsburg.
8806	(a) Queen Snake (R. leberis), (b) 2 Newts (D. viridescens),	2	R. W. Wehrle, Indiana.
8810	(2) Rock Snakes (S. dakayi),	2	J. A. Mark, Bethlehem.
8817	(a) (2) Common Garter Snakes,	2	G. M. Lehman, Essington.
8820	Common Garter Snake,	3	E. P. Shook, Spring Mills.
8829	Common Garter Snake,	4	F. Mayer, Johnstown.
8830	Blacksnake (B. constrictor),	4	D. Vogel, Marysville.
8836	Common Garter Snake,	5	D. L. Harstine, Ferndale.
8840	Red-bellied Snake,	6	E. P. Shook, Spring Mills.
8852	Brown Salamander (D. fusca),	9	W. C. Dickson, Wayne.
8857	Blacksnake,	9	C. A. Palmer, Warfordsburg.
8870	(5) Land Salamanders (P. cinereus),	12	W. C. Dickson, Wayne.
8876	Rock Snake,	12	J. T. Blake, Fox Chase.
8877	Common Water Snake (N. sipedon),	12	Rev. E. M. Gearhart, Sunbury.
8886	Spotted Salamander (A. punctatum),	15	J. E. Avery, Notch.
8899	Common Water Snake,	17	R. L. Jackson, McConnellsburg.
8904	Striped Lizard (E. fasciatus),	18	H. Heffner, Leeper.
8918	Alligator,	20	————, Florida.
8944	Rock Snake,	24	W. C. Reeder, Holmesburg.
8952	Red Salamander (S. ruber),	25	Grace Brightbill, Marsh Run.
8954	Common Garter Snake,	25	P. H. Mulford, Mt. Alto.
8955	Ring-necked Snake (D. punctatus),	25	J. G. Dillin, Foltz.
8956	(a) (2) Common Garter Snakes,	26	H. L. Meredith, Harrisburg.
8966	Rock Snake,	26	S. M. Partington, Harrisburg.
8972	(4) Common Garter Snakes,	27	R. D. Spencer & B. G. Van Housen, Williamsport.
8978	Red-bellied Snake,	29	Mrs. M. C. Brightbill, Marsh Run.
8987	Purple Salamander (G. porphyriticus),		State Museum, Harrisburg.
8990	Common Garter Snake,	30	G. R. Styer, Berwick.
8991	Red Salamander,	30	State Museum, Harrisburg.
9003	Common Hoptoad (B. l. americanus),	30	A. B. Miller, Barnesville.
	Birds and Mammals.		
8817	(b) Young Rats,	2	G. M. Lehman, Essington.
8821	Robin,	3	E. E. Berg, Mt. Pleasant.
8822	Star-nosed Mole,	3	G. F. Hoy, Hubersburg.
8827	Cardinal Grosbeak,	3	J. Couch, Canonsburg.
8846	Chipping Sparrow,	8	C. L. Knier & C. H. Forrest, Wormleysburg.
8862	Chipping Sparrow,	10	E. Branthaver, Chambersburg.
8891	Short-tailed Shrew (B. brevicauda),	15	F. Ruof, Hummelstown.
8897	Sparrow Hawk,	16	D. C. Manley, Wellsboro.
8910	(a) Horned Grebe, (b) Red-breasted Merganser,	19	C. L. Woodcock, Raymond.
8958	Slate-colored Junco (J. hyemalis),	26	Mrs. D. W. Braillier, Conemaugh.
8959	White-bellied Nuthatch,	26	Mrs. D. Card, Emporium.
8967	Chipping Sparrow,	27	C. L. Brumbaugh, Wilkinsburg.
8971	Hooded Merganser,	27	C. L. Woodcock, Raymond.
8977	(a) Blue Jay,	29	J. B. Richard, Barto.
8989	American Bittern,	30	B. E. Foley, Wimmers.

This office is indebted to the persons named above for their valued aid, and our thanks are hereby extended. Additional specimens are desired. Send by express or mail to H. A. SURFACE, Economic Zoologist, Harrisburg, Pa.

THE

ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

SUBJECTS: Formulae and Insect Pests.

VOL. V, No. 2.

June 1, 1907.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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1907.

THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR JUNE, 1907.

Volume V, No. 2.

Established in April, 1903, at the office of the Economic Zoologist, Edited by H. A. Surface, Economic Zoologist. Harrisburg, Pa.

CONTENTS OF THE JUNE ISSUE.

OUR MONTHLY CHAT WITH READERS.

A CORRECTION.—Notwithstanding the most careful proof reading, errors are liable to occur in our Bulletins as in other publications, and when these are only mistakes of grammar, punctuation or printing, we do not count them sufficiently important to take time and space to correct them, but when they become errors of scientific facts or statements, it is important that they be corrected. For this reason we call your attention to the omission of one important word in the middle of page 386 of the March Bulletin. The third paragraph reads "Other enemies of the Cabbage Root are known to be small Carabid Beetles or Ground Beetles." The truth is that Carabid Beetles or Ground Beetles are among the most beneficial of insects, because they are predaceous, feeding upon other insects, most of which are pests. In this case the Carabids were found by our field assistant feeding upon the Cabbage Root Worm, and consequently the word "Maggot" or "Worm" should be inserted after the word "Root" in line 23 of page 386. It makes a difference to the cabbage grower that is of considerable importance.

CHANGE OF TITLE.—Readers of the Bulletin may notice the change in the title of the Bulletin and the appearance of the first page. This was done for the purpose of reducing the amount of printing and the various styles of type used on that page, and to give a definite title that could be used by librarians in indexing these publications in the different libraries of the country. Also the general subject of each Bulletin is inserted in the first page in such a way as to give the reader an idea of the contents. The detailed statement of contents will be continued on the second page as in the past. These Bulletins reach libraries in practically all civilized parts of the World, in exchange for publications useful to this office, and librarians have found it important to make use of such systems in their cataloging. As a consequence this Bulletin will hereafter be known as the "Zoological Bulletin of the Division of Zoology." It will be published monthly until further announcements are duly made in its pages. It is, of course, sent free to all persons who request it.

THE ENLARGED ISSUE.—The Economic Zoologist is pleased to be able to report to readers of the Zoological Bulletin of this Division that the last Legislature provided for an enlarged issue of the Bulletin, enough to meet the demands of the people. This bill met with the approval of Governor Stuart, and we are now able to add to the mailing list all the names sent to us to the extent of twenty-

five thousand more. Unfortunately, the March and April issues are already practically exhausted, and they will not be re-printed, although arrangements may be made for a republication of the August-September issue, 1906, which is now known as the Pennsylvania Snake Bulletin. Schools, clubs, societies and other organizations, libraries or individuals desiring future issues of these Bulletins may obtain, free, whatever number they desire by writing to this office for them.

THE NEXT BULLETIN.—The next Zoological Bulletin will be on the subject of the Hemiptera or a Suborder of the Order of Insects known as Hemiptera or True Bugs, the discussion of which was commenced in the Bulletin for June, 1906.

Those who have watched our Bulletins carefully know that our plan has been to discuss all of the various Orders of the Insects found in Pennsylvania, beginning with the lowest and continuing through to the highest. The Bulletins upon Insects are monographic or completing one particular Group at a time. These are issued as numbers of the Monthly Bulletin and several have already been prepared, and more will follow before the various Orders of Insects are discussed in their economic and practical relationships. This explanation is made in order that readers can understand the apparent break in the Bulletins due to the insertion of a discussion of a Group of Insects instead of the regular treatment of formulae and pests.

SPECIMENS WANTED.—To aid in our investigations of insects and enemies, the office of the Economic Zoologist desires to receive specimens of insects of all kinds as well as their enemies. We especially wish specimens of amphibians or salamanders, newts and frogs, as it is our desire to make the October Bulletin upon this subject. We also desire specimens of reptiles, including the serpents, turtles and lizards. Insects should at all times be sent in such manner that they will not be crushed in the mail, and larger specimens may be sent by express, at our expense. We particularly desire that all reptiles and amphibians be killed before sending them, in order that the food which they have eaten will be preserved, and we can make a careful study of their stomach contents. We do not ask for toads, as they have been sufficiently studied to be well known, and there is no question of their great economic value. The name and address of the sender should be on or in each package.

Address all packages and communications to H. A. Surface, Harrisburg, Pa.

PART I. FORMULAE AND METHODS—Concluded.

I. E. PRACTICAL PREVENTIVE MEASURES.

X. Farm Practice.

64. Rotation of Crops, as for Wireworms, Corn Root Worms, Hessian Fly, etc.

65. Selection of Good Stock or Seed.

This is necessary with both plants and animals in order to secure immunity from diseases and pests and obtain the best results.

66. Starting Plants Early and Setting Strong Plants.

By getting ahead of the insects at the start one can often keep ahead of them. This is especially true of such pests as the Striped Cucumber Beetles, Flea Beetles and others.

67. Proper Dates of Farm Operations.

(a) Of Plowing, as in plowing very late in fall and very early in spring for Cutworms, Wireworms and other insects in the soil, and also midsummer plowing to destroy the Hessian Fly in wheat stubble.

(b) Of Planting, as in planting wheat late to avoid the Hessian Fly, planting cabbage early to avoid Cabbage Root Worms and planting it at such time as will come between the broods of this pest.

(c) Of cultivating, as in cultivating late in fall and early in spring to avoid Cutworms and Wireworms, and also cultivating in August and September to destroy the Apple Maggot and Plum Curculio in the soil.

(d) Of Harvesting, as in gathering cabbage before it is attacked by Black Rot, picking berries before they are injured by fruit-eating insects and birds and mowing cultivated hay before the Clover-head Midge is sufficiently mature to pass to the ground and live.

68. Early Destruction of all Unused Parts of Plants.

This is important whether insects or plant diseases be present upon the plants or not. As soon as peas are picked the vine should be burned to destroy the Pea Lice, when cabbage is cut the stocks should be burned, when potatoes are lifted from the ground the vines should be burned, as soon as strawberries are picked the leaves should be mowed as closely to the ground as possible, dried in the hot sun, raked together and burned. This will prevent leaf blight and other pests. When blackberries and raspberries are gathered, the canes should be cut at once and burned. When wheat is har-

vested in which Hessian Fly was present the best means of preventing its recurrence the coming fall is to plow down or burn over the stubble at once. This will be an important principle to apply to nearly all crops.

69. Immediate Destruction of Fallen, Infested and Decaying Fruits.

Some insects, such as Apple Maggot or Railroad Worms, Curculio of Plum and Peach, Codling Moth and other pests, remain in fallen fruit a short time before passing into the soil to pupate or transform. If these fruits be destroyed as soon as they drop the pests are killed. When infested or decaying fruits are seen on vines and trees or on the ground beneath them, they should be gathered and burned at once, destroying both the insects and the germs of plant diseases. Pasturing orchards with pigs and sheep is one means of accomplishing this destruction of fallen fruits.

70. Clean Farming.

(a) Clearing away Rubbish, as in burning brush, leaves and grass, etc., to destroy the hibernating places of insects, and especially to prevent mice from finding concealed quarters in orchards, which they gnaw if left covered with leaves and grass.

(b) Clearing away Weeds, as in destroying mustard and preventing the occurrence of lice and root worms injurious to grapes and other cultivated plants of the mustard family. Many kinds of weeds are liable to sustain insects that may become injurious to various cultivated plants, and even plant diseases are at times transferred from weeds to cultivated plants of choice varieties. Prevent this by this important method of clean farming.

(c) Clearing away Volunteer Plants, etc., as in destroying the volunteer or self-planted wheat stocks of late summer to prevent the Hessian Fly from developing on them and becoming a menace to cultivated crops planted later. The destruction of wild or volunteer fruit trees by the tens of thousands in this State would prove of immense value to the careful orchardists who spray continuously for the Codling Moth and other orchard pests, such as the Tent-caterpillar and scale insects, and as regularly have their orchards reinfested by the pests that are continually propagated upon the wild or seedling fruit trees in their regions.

(d) Pruning, Clearing away Extra Branches and Dead and Dying Trees, etc.

The cause of the death of a branch often remains in the branch and can be removed by cutting it away or pruning the living wood. One should always cut some inches below the dead branch to be sure to remove the cause of the trouble. Pear Blight, Bark Beetles and other pests and diseases are to be removed by this as the best possible method.

71. Proper and Frequent Cultivation.

Not only are plants greatly strengthened by this important means of farm practice, but insect pests and plant diseases are greatly discouraged thereby.

72. Draining Wet Land, as for Cutworms and Wireworms, and especially Mole Crickets on damp soil.

73. Irrigating Dry Land or Occasionally Flooding.

Wherever it is possible to flood land for a few weeks during the fall or winter, the pests in that soil will be killed. Recent Bulletins have shown that the best method of treating some pests, such as various kinds of cranberry insects, is to flood the cranberry bogs for even a short time (24 hours) occasionally while the pests are on the growing plants.

74. Strengthening Trees by Pruning, Thinning Fruit, Fertilizing, etc.

Every means of farm practice that will strengthen trees will aid them in withstanding the evil effects of pests. The importance of thinning and pruning have been discussed in our previous Bulletins. (See Vol. II, page 81.)

75. Use of Quickly Acting Fertilizer for Infested Plants.

It is recommended to strengthen certain plants such as wheat by sowing over them when infested some quickly acting fertilizer, such as nitrate of soda, two hundred to three hundred pounds per acre. This acts as a stimulant during the time when insects are most likely to have a killing effect.

76. Killing Pests While Few in Number.

Occasional outbreaks of insects in great numbers is often due to the neglect of persons while they were but few. This is especially true of the Stinking Squash Bug, which may not be perceptibly injurious while few in numbers, and consequently might be neglected, with the result that during the next season they may become very abundant, and it would then be almost impossible to treat them effectively.

77. Planting Trap Crops to Catch and Destroy Pests.

A trap crop may be early planting of seeds of plants of some kind to be protected, as in planting early squash to become well started and receive the eggs of the Squash Borers and protect the latter and more desired crop, or as in planting a strip of early wheat at the side of the field, which is to be sown later and thus trapping the Hessian Fly, which will lay its eggs in the early strip. By destroying the trap

crops when the pests have become well started in them, the insects are exterminated or suppressed. Another kind of trap crop consists of some kind of plant that may be used to take insects from cultivated plants, as in planting mustard seed to produce plants to catch the Cabbage Root Worms and Cabbage Plant Lice, and destroying these plants when infested, or planting a few beans among cucumbers or melon plants to attract Flea Beetles from the vining plants.

XX. Mechanical Devices.

78. Protecting Plants by Nets, Boxes, etc., as in covering vining plants with nets to keep out Cucumber Beetles, Squash Bugs, and other pests.

79. Bands around Trees for Climbing Insects, as in wrapping trees with wool or some sticky substance to prevent Canker Worms and Climbing Cutworms from ascending.

80. Wrapping.

(a) Trees for Borers, Mice, etc., as in wrapping trees with paper or wire netting to prevent borers from reaching them or depositing their eggs, and prevent mice from gnawing them.

(b) Plants for Cutworms, as in wrapping small sheets of paper around garden plants when set in the soil to prevent Cutworms, Wireworms, etc., from attacking them.

81. Painting.

(a) With Paint, as in painting trunks of apple, pear and quince trees with white lead and linseed oil to prevent borers from laying their eggs and entering them.

(b) With Soap, as in painting trunks of trees with soap to kill pests and also prevent borers.

82. Paper Pads or Disks around Plants, as in spreading disks of heavy paper, and putting them flat on the ground around cabbage plants to prevent flies from laying their eggs that hatch into Cabbage Root Worms.

83. Impassable Barriers.

(a) Ditches, Furrows and Holes, such as are made around fields that would be attacked by migrating hosts of insects, such as Army Worms, the young or wingless Grasshoppers and Chinch Bugs.

(b) Line of Tar, as in making an impassable band to serve the same purpose for similar pests.

(c) Tin, Boards, etc., placed around fields or plants to be a protection to prevent certain insects, such as wingless Grasshoppers, from passing them.

XXX. Chemical Preventives or Repellants.

84. (a) Ashes, (b) Soot, (c) Dust, etc.

These substances are used around beds of plants in gardens to keep out such pests as snails and slugs, and may also be dusted over plants to prevent insects from attacking them.

85. (a) Camphor, (b) Moth Balls, (c) Cedar Oil, (d) Heliotrope.

These are substances to place in closed vessels, chests, closets or cases to keep pests from entering. They will not kill Clothes Moths or other pests, but if they be in closed receptacles will generally prevent them.

86. Fish Oil.

The chief virtue of Fish Oil is as a repellant, rather than a means of killing insects. (See Formula 33.)

87. Kerosene.

(a) Kerosene Sand. By adding a quart of Kerosene to about one peck of sand and stirring it well, a mixture is made which will repel insects, and keep them from laying their eggs around the roots of plants, as in placing a handful of this mixture near the roots of cabbage plants or around onions for the root worms of these plants.

88. Tar, as in using a teaspoonful of tar in a quart of warm water to pour over one-half bushel of corn to make it bitter and prevent crows from pulling it, or ground-inhabiting insects from eating it while in the ground. But note that this will only protect the grain and not the young shoots that come from it.

89. Lime, as in dusting this substance over the leaves of plants, such as cucumbers and melons to prevent insects from attacking them. Its value as a repellant will be increased by the addition of a little turpentine.

90. Nitrate of Soda.

This has been recommended to mix in the soil around the roots of plants to strengthen them, at the rate of three hundred pounds per acre. It acts not only as a quick fertilizer for plants but also as a repellant to keep out certain insects.

91. Turpentine.

When added to lime or some other substance that will absorb it and placed around plants it has some effect in repelling certain kinds of insects.

XXXX. Vital Means.

92. Strengthening Crops by Fertilizing, Cultivating, Pruning, Thinning, Watering, Draining, etc.

Every means by which plants can be strengthened is a vital means in enabling the plant to withstand the attacks of enemies, whether they be insects, plant diseases, or other pests.

93. Destroying Allies of Injurious Insects, as in using various means to destroy ants in corn fields that protect the root lice on corn plants.

94. Preserving Beneficial Insects, as in watching for lady beetles, or ladybirds, and parasites on our various insects and permitting them to remain undisturbed.

95. Preserving Insectivorous Reptiles, Birds and Mammals, such as Striped Snakes or Garter Snakes, Black Snakes, Green Grass Snakes, nearly all Birds and also Skunks, Moles, etc.

The importance of preserving beneficial insects and insectivorous animals is too great to be passed without a few words of emphasis. The insect pests in our country are increasing rapidly and there is not a year that does not see new species introduced. The introduction of obnoxious pests is far greater than the introduction of those that are beneficial, for as the chief allies of the former in holding these pests in suppression are their natural parasites and insectivorous birds and other animals, we can see that by far the best thing to do is to learn how to recognize these important allies in order to secure their continued co-operation in destroying our foes. The natural enemies of pests are more powerful, as a constant and effectual check upon their increase, than any spraying operations that can be performed. To learn to know these natural enemies requires care, time and close observation, but the effort is fully justified.

Part II. The List of Cultivated Plants with Prominent Pests of Each and Methods of Treating the Latter follows:

CALENDAR FOR 1907.

PART II. PLANTS, PESTS AND TREATMENT.

Plant.	Insects or Disease.	Treatment.
Apple,	Aphis or Plant Lice,	(1) About the time the buds burst use Kerosene Emulsion, repeat this at any time the Aphids or Plant Lice are present before the leaves become curled to cover them. (2) Spray with Whale Oil Soap Solution in place of Kerosene emulsion. Repeat as needed. (3) After the leaves become large and twisted so that the Plant Lice are protected make a strong solution of soap and water and by holding this in a pan and bending the infested twigs so that the leaves are dipped into the solution they will be washed and the Lice will be killed by coming into contact with it.
	Codling Moth,	Spray with Paris Green or Arsenate of Lead as soon as the blossoms have fallen and repeat ten days later. Scrape the loose bark from the trunks. Fruit fallen early should be fed to pigs. Protect the little Woodpeckers, wrongly called "Sapsuckers."
	Bud Moth,	Spray with Paris Green or Arsenate of Lead as soon as the green leaves show in the buds. Repeat just before the blossoms open and again after blossoms fall.
	Bitter Rot,	Spray with Bordeaux Mixture before the blossoms open, and again after the blossoms fall. Repeat every ten days until the fruit begins to ripen.
	Canker Worm,	Spray with Paris Green or Arsenate of Lead as soon as the Caterpillars appear. Repeat in a day or two if all are not killed by the first application. Also, cultivate thoroughly in June and July to break up the cells in which they pass the winter. Destroy eggs in April. Put bands of loose cotton, wool or sticky substance around the trees in February and March.
	Borers,	Drive sulfur matches into their holes. Dig them out in the fall, or inject carbon Bisulfid and plug the holes with clay, or wrap trunk of tree from below the surface of the ground to a foot above, during June, and allow to remain this way until December. Whitewash, with Paris Green added to the regular mixture, the trunks of trees during June. Paint trunks in May or early part of June with pure White Lead and Linseed Oil.
	Case Bearer,	Same treatment as for Bud Moth.
	Leaf Rust,	Destroy all red cedar trees near the orchard, as one of the necessary steps in the life history of the Apple Rust is in the form of Cedar Apples or the knotty balls on red cedar trees.
	Oyster-shell Scale and Scurfy Scale.	Spray while trees are dormant with the Lime-sulfur Wash or spray about May 25th with dilute Whale Oil Soap or other mild contact insecticides.
	San José Scale,	(a) When trees are dormant or without leaf: (1) Cut back the trees in proprtion to their injury, and paint every part of the bark with a Lime-Sulphur Wash or with a thick solution of Soap. Apply it by hand, using a paint brush and go over the trees at least twice, to be sure they are well coated. (2) Spray with the Lime-Sulphur Wash, or with Whale Oil Soap, two pounds in one gallon of water. (3) Repeat these opera-

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Disease.	Treatment.
		tions in the spring as late as possible before the buds burst, even through they may have been performed in the fall when the first application should have been given. (See previous Bulletins of this Department in order to learn which material is best to use according to the size of the orchard, the trees, and other local conditions.) (b) When trees are in foliage: Spray at least four times at intervals of five or six days each with Kerosene Emulsion, eight or ten per cent. or Whale Oil Soap, one pound in six or seven gallons of water, or other contact insecticides. When a few trees are badly infested it will be much better to cut them out and burn them in order to save others, or paint them at any time of year by hand with a brush using thick Whale Oil Soap, or other soap solution or Lime-sulphur Wash. This can safely be done in the summer if the insecticide is kept off the leaves. Buy no trees excepting from reliable nurseries and insist upon their being accompanied by tags showing that they have been both inspected and fumigated.
	Scab,	Spray with Copper Sulfate before the buds burst and with Bordeaux Mixture just before the blossoms open and again after the petals fall, and at intervals of ten days until the fruit begins to ripen.
Apricot,	See "Peach,"	Treatment is the same as on Peach trees.
Asparagus,	Beetles,	(1) Cut the entire patch to destroy food supply. (2) Give the chickens the run of the patch. (3) Dust with Air-slaked Lime or with Flour and Pyrethrum, or spray with Paris Green after cutting has stopped.
	Rust,	(1) Cut all plants low and frequently. (2) Spray with Bordeaux Mixture after the cutting has stopped. (3) Burn the rusted plants in fall before they are entirely dead.
Beans,	Anthracnose (or Red Spot),	(1) Spray with Bordeaux Mixture when the first true leaves have formed. (2) Repeat with Bordeaux Mixture often enough to keep the mixture on the plants until shortly before the pods are to be eaten. (3) Soak the seeds for one hour in Cupram or Formalin before planting them.
	Mildew,	(1) Spray with Potassium Sulphide before it appears. (2) Burn all parts of the plant as soon as possible after the best part of the crop is gathered.
	Weevil,	Fumigate the seed as soon as gathered and again before planting with Carbon Bisulphide or Hydrocyanic Acid Gas.
Beet,	Leaf Spot,	Use the Bordeaux Mixture three or four times when the beets are first large enough, and repeat this as often as necessary to keep the mixture on the leaves. Burn leaves as soon as gathered.
	Leaf Miners,	Same treatment as Leaf Spot, with Paris Green added to the mixture. Cultivate thoroughly the last of June.
	Rust,	Same treatment as for "Leaf Spot."
Cabbage and Cauliflower.	Plant Lice,	(1) Spray with Kerosene Emulsion whenever the insects are present and use Resin or Soap to make this adhere. Repeat whenever the lice are seen. (2) After the plants become headed use Tobacco or Hot Water. (3) Spray with Soap Solutions.
	Caterpillars,	(1) Destroy by hand-picking. (2) Spray with Paris Green and an adherent until the plants commence to head or the cauliflower to form.
	Club Root,	(1) Burn infected plants as soon as they are found to have the disease. (2) Practice rotation of crops to put the plants on soil that do not carry these germs. (3) Treat the seed before plant-

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Disease.	Treatment.
		ing with Corrosive Sublimate or Formalin. (4) Use lime 75 bushels per acre in rows where cabbage is to be planted. (5) Inject a half-teaspoonful of Carbon Bisulphide into the soil around the roots of each diseased plant.
	Cabbage Worm,	(1) Spray with Paris Green or Arsenate of Lead, or Kerosene Emulsion, or Kerosene Mixture. (2) Repeat No. 1 as often as enough Cabbage Worms are seen to justify the treatment. (3) After the heads of the plants are half-formed use Hellebore, or Hot Water, or Kerosene Emulsion. The poisons may be safe but it is not best to recommend them. (4) Dust the plants with fresh Lime and Pyrethrum while the dew is on.
	Harlequin Bug,	(1) Plant an early trap crop or mustard to catch the bugs, then spray them with pure kerosene to kill them. (2) Pick them by hand.
	Root Maggot,	(1) Rotate crops and plant as far as possible from where this pest was present the previous year. (2) Sprinkle each plant with a solution of Whale Oil Soap, using one pound to eight gallons, and apply enough of the solution to permit it running down the stalk and among the roots of the plants. Do this early before the larvæ have worked down to much depth. (3) Lean the plants to one side and apply one-half teaspoonful of salt pushed down at the side of the plant to the roots. (4) Inject a half-teaspoonful of Carbon Bisulphide among the infested roots and close the hole.
Carnations,	Authracnose (or Rust Spot),	Use Bordeaux Mixture or Cupram, or Soda Bordeaux at the first signs of rust. Repeat this every two weeks until the flowers appear, then use Ammoniacal Solution of Copper Sulphate to avoid the blue stain.
	Red Spider,	Knock these off house plants by using forceful jets of water, as from a hose, or use Kerosene Emulsion or Whale Oil Soap or Potassium Sulphide. Dust with sulphur and lime.
	Mildew,	See Bean-Mildew.
Celery,	Blight or Rust,	Cupram, repeat once a week. Arrange a shade over plants.
	Caterpillars,	Use Paris Green, while the plants are small, if the caterpillars be very numerous, or pick them off by hand, at any time, especially when the plants become larger.
	Soft Rot,	(1) Keep the plants dry. (2) Keep the plants entirely submerged under pure water.
Cherry,	Aphis,	See "Apple"—Aphis.
	Black Knot,	See under "Plum."
	Curculio and Wooly Aphis,	See under "Plum."
	Rot,	(1) Bordeaux Mixture when the buds burst or before the blossoms open. Repeat when the fruit has set. (2) Use Cupram when the fruit is full-grown and again just as it commences to show the first signs of ripening.
	Leaf Blight,	Same treatment as for "Rot."
	Slug,	(1) Spray with Paris Green or Arsenate of Lead, or Hellebore, or dust with air-slaked lime. The Dust Spray with Paris Green is very good. Repeat whenever the slugs are seen.
Chrysanthemum,	Leaf Spot,	Spray with Bordeaux Mixture or Cupram every two weeks or as often as necessary to keep the material on the plants. Repeat this and use Cupram after the blossoms commence to appear.
	Rust,	Spray frequently with Potassium Sulphide.
Corn,	Cut Worms,	(1) Trap by poison baits at any time they are present. (2) Rotate crops in such a manner as to avoid corn upon grass sod especially sod of long stand-

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Disease.	Treatment.
		ing. (3) Where it is necessary to plant corn on sod plow the ground in fall and cultivate the ground frequently both as early as possible and as late as possible in fall. Put poison baits in the rows where the corn is to be planted before it is planted or before it is up.
	Boll Worm or Corn Worm,	Pick the pests by hand. Plow late in fall to destroy them while in the ground.
	Smut,	Cut out and burn all smut bolls of diseased plants as soon as they are discovered and never permit them to remain in the ground or in manure piles over the winter. Rotate crops where manure is badly covered so that it is not followed soon by corn.
	Corn Root Worm,	Rotate crops to avoid frequent planting of the corn in the same ground as this is the best means of overcoming this species of corn pest.
	Lice and Ants on Roots,	(1) Rotate crops. (2) Fall plowing. (3) Late cultivation and early spring cultivation to kill all weeds, stir up the soil in which the plant lice live. (4) Frequent cultivation of infested corn field.
	Web Worms,	There is no remedy when once planted. Prevent by fall plowing, late planting and thorough cultivation.
	Wire Worms,	(1) Rotate crops so that corn does not follow grass. (2) Plow late in the fall and cultivate early and well. (3) Sow 1,000 pounds Kainit to the acre. (4) Make poison baits.
Cucumber, Melon, Squash.	Downy Mildew,	Bordeaux Mixture on plants enough to keep them covered. (2) Burn the vines as soon as possible after the crop is gathered.
	Blight,	Same treatment as for "Mildew."
	Borer,	(1) Use a very dilute mixture of Paris Green and Flour, applying it as a dust over vines. (2) Bury the vines at intervals to permit them to take root at several places. (3) Cut out the Borers by lengthwise cuts wherever they occur. (4) Kill the adult moths by hand picking on and beneath the leaves. Collect in the morning and evening and when damp.
	Striped Cucumber Beetle,	(1) Cover the plants by a net until they are well started. (2) Dust them with air-slaked lime and Paris Green, or with air-slaked lime and turpentine, or use other repellants. (3) Dust with tobacco, and put an abundance of powdered or refuse tobacco about the stems and in the soil to keep them from laying their eggs in the soil where the young feed upon the roots.
	Squash Bug,	(1) Pick them by hand and kill them. (2) Spray with Kerosene Emulsion or Whale Oil Soap when they are on the ground. (3) Place board traps for them. (4) Spray with Kerosene or another very strong contact insecticide in the fall as soon as the plants are no longer valuable and while these pests are yet present. (5) Burn vines as early as possible.
Currant,	Currant Worm,	Paris Green or Hellebore as a dust or liquid spray when the worms first appear. Repeat whenever necessary.
Gooseberry,	Four-lined Leaf Bug,	Kerosene Emulsion one part to five parts water.
	Gooseberry Fruit Worm,	(1) Let fowls run among the plants to devour the pests and the infested fruit as often as it falls. (2) Pick off the infested fruits and destroy them whenever they are to be found. (3) Rake up and burn the fallen leaves near the bushes in the fall. (4) Spray with an arsenite before the fruit is half-grown.
	The Stem Girdler or Borer,	Cut the infested stems some inches below the girdled place and burn them.
	Leaf Blight,	Spray with Cupram. (1) While the fruit is present. (2) After gathering the fruit with Bordeaux Mixture to keep the leaves covered.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
Egg Plant,	Leaf Spot,	Bordeaux Mixture as soon as the leaves are out, and repeat this as often as is necessary to keep the leaves covered. Use Cupram when the fruit is nearly ripe enough to gather. Gather and burn the fallen leaves.
Elm,	Elm-leaf Beetle,	Spray with Arsenate of Lead, or Arsenite of Lime when the leaves first appear and repeat this as often as any pests are to be found attacking them.
	Tussock Moth,	(1) Gather and destroy the egg masses on the trunks and larger branches before they hatch in spring. (2) Spray with arsenites when the caterpillars feed. (3) Destroy the egg masses of the second brood in midsummer.
Grape,	Anthracnose: or Bird's Eye Rot.	(1) Wash with Iron Sulphate and Sulphuric Acid, or Copper Sulphate one pound in ten gallons before the buds open, and repeat this three or four days later, but do not apply this strength after the leaves start. (2) Spray occasionally with regular Bordeaux Mixture.
	Black Rot,	(1) Bordeaux Mixture when the buds are bursting. Repeat every two weeks until fruit is half grown. (2) Then use Copper Carbonate and Ammonia, repeating every week or two if any evidence of rot appears. Pick off and burn all rotting grapes just as soon as they are seen.
	Downy Mildew,	(1) Spray with Bordeaux Mixture as soon as the leaves have expanded. Repeat in about ten days or just before the flowers open. (2) Spray with Potassium Sulphide at any time there is evidence of the mildew appearing.
	Grape-vine Leaf Hopper,	(1) Dust the vines with insect powder or tobacco dust about the first of July. Repeat whenever the pests are present. (2) Instead of dust spray with dilute Kerosene Mixture, not over five per cent., or dilute Kerosene Emulsion, forcing the insects to fly to the ground and then immediately spray them on the ground with a stronger mixture or emulsion and kill them there where the leaves of the grape will not be injured by the stronger spray.
	Powdery Mildew,	(Same treatment as for "Downy Mildew).".
	Ripe Rot,	(Same treatment as for "Black Rot," but use the Cupram until fruit is ready to gather, or until there is no danger of rot.)
	Root Worm,	(1) As soon as the adult beetles appear on the leaves give the same treatment as for the Grape Vine Flea Beetle. (2) Inject Carbon Bisulphide into the soil around the roots.
	Rose Bug,	(1) Pick the beetles by hand as soon as they appear, or jar them from the vines on sheets or bug catcher, or jar them or shake them from the leaves and spray them with Kerosene, either mixed or pure, while they are on the ground where the leaves will not be injured by the spray. (2) Cover the forming bunches of grapes with paper bags.
Hollyhock,	Rust,	Bordeaux Mixture as soon as the leaves open. Repeat this at intervals of ten days until there is no danger of rust appearing.
House Plants,	Aphids or Lice,	(1) Spray or wash with soap solution whenever they are seen, or (2) Hold the infested plants in steam a few inches from the mouth of a tea-kettle for a few seconds, or use hot water.
	Mealy Bugs,	Same treatment as for "Plant Lice or Aphids," or touch with a small brush dipped in pure Kerosene.
	Nematodes or "Root Worms."	(1) For potting plants use soil that has been from sod one year or more. Heat the earth for three hours before using it either in an oven or with forty to

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
		sixty pounds of steam. (2) Inject Carbon Bisulphide into infested soil. (3) Remove the soil containing the little white worms on the roots of the plants, wash the roots in warm water, and repot at once with clean soil.
	Scale Insects,	(1) Treat frequently as for "Aphids or Plant Lice." At the time the young scale insects appear in their soft and unprotected state, they are easily killed by those methods. (2) Use remedies for scale insects mentioned elsewhere in this Bulletin. (See under "Apple.")
Household Pests,	Ants,	(1) Trace them to the nest and destroy by pouring in Kerosene, Benzine, Gasolene, or Carbon Bisulphide. (2) Moisten sponges with sweetened water and drop these into boiling water whenever the ants cover them. (3) Many substances are recommended to place on shelves to drive away ants. Among these are red pepper, powdered borax, walnut leaves, pennyroyal, cedar oil, oil of cloves, etc., but nothing is as good as destroying the nest.
	Bedbugs,	(1) Fumigate the infested room with Hydrocyanic Acid Gas, or Carbon Bisulphide. Keep it closed at least one-half day, then ventilate it well and there will be no danger. Remember the very deadly effect of these gases when inhaled even in small quantity. This is about the only way to clean up a badly infested house. (2) Dissolve Corrosive Sublimate in Alcohol.
	Carpet Beetles,	For pests in carpets: (1) Use a damp towel and hot flatiron. (2) Spray with Corrosive Sublimate and Alcohol, especially under furniture and around the edges of the carpet both beneath and above. (3) Discard the use of carpets and use rugs instead, beating them frequently in the sunshine. (4) Fumigate the infested room as for bedbugs. (Note fumigation by either Carbon Bisulphide, or Hydrocyanic Acid Gas when properly done with the building tightly closed will kill absolutely all kinds of insects and animals, such as rats and mice that are in the building. We have done this work and have proven it effective for ants, bedbugs, carpet insects, clothes moths, fleas, flies, and rats and mice. Any pests in the house will be killed by one and the same fumigation.)
	Clothes Moths,	(1) Put woolen clothing and furs in tight paper sacks in the spring before the moth has laid her eggs in them and tie them tightly so she can not enter. The desired results are also obtained by putting such articles into boxes of any kind that are tight, and seal them with strips of paper. (2) Use cedar boxes or chests for storing, or use an abundance of moth balls, cedar oil, lavender, or some other repellent. Remember that these will not kill the insect after it has once entered the clothing, or if it be infested when packed away, but will only keep the moth from laying her eggs where they are used. (3) Fumigate infested clothing in tight vessels, such as wash boilers, barrels or hogsheads. (4) Where clothes moths infest articles that are not injured by boiling, they can be killed by putting them into boiling water for some minutes. (5) Thoroughly brush infested clothing in the open air and hang it in the sunshine for a day. (6) Fumigate the entire house, room, or closet in which the pests are found.

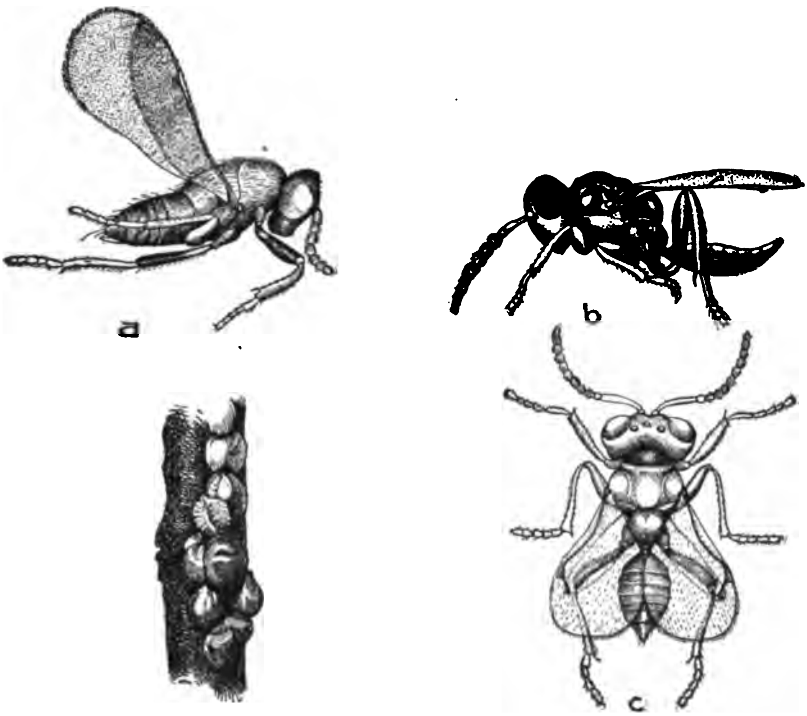
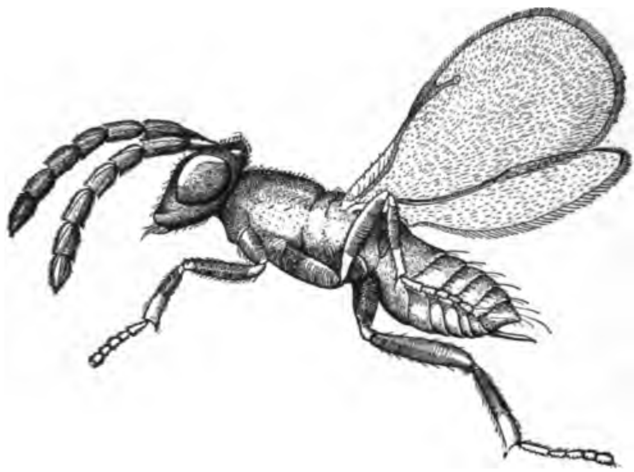


PLATE IV.—Lecanium sp. on Mulberry, slightly enlarged. Fig. a, *Coccophagus immaculatus* Howard, enlarged 30 diameters; b and c, *Pachyneuron micans* Howard, enlarged 30 diameters, Chalcid parasites bred from Lecanium. Drawn in the office of the Economic Zoologist, by W. R. Walton. Specimens sent by Mr. F. G. Stokes, of Philadelphia.

A



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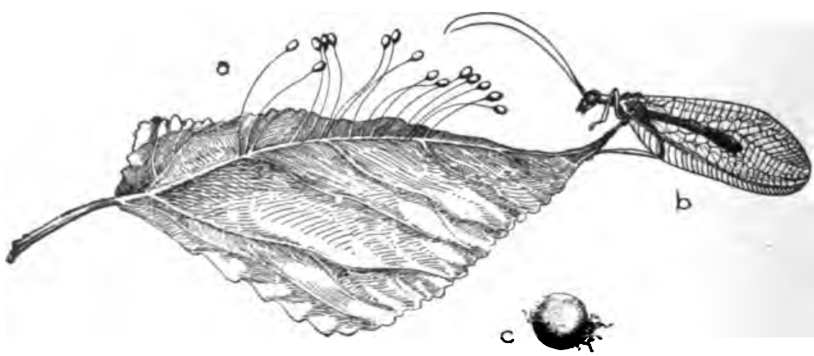

PLATE V.—Fig. A, (*Physcus varicornis* Howard) Chalcid Parasite of Scurfy Scale on Pine, enlarged 65 diameters. Drawn in the office of the Economic Zoologist, by W. R. Walton. Fig. B, Lace-wing (*Chrysopa oculata*); (a) eggs on egg-stalks; (b) adult; (c) cocoon; enlarged 2 diameters. Drawn in the office of the Economic Zoologist, by W. R. Walton. Specimens sent by the Zoological Society of Philadelphia.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Fleas,	(1) Place rugs or carpets for the dogs and cats to sleep on, and shake or beat these rugs on the grass away from the house every few days. (2) Clean up the sleeping places of dogs and cats as here is where the eggs of most fleas are laid and the young hatch. (3) Scrub infested pets with tar soap, or better, water with three per cent. creolin. (4) Clean the cracks of floors from dust, and fill them with paint, putty or some other substance that will keep the young fleas from living in the dust in such places. (5) Put sticky fly paper on the floor beneath tables and chairs to trap the adult fleas as they jump around. (6) Tie sticky fly papers around boot tops with the sticky side out and walk slowly through the rooms and halls that are infested. Fleas jump toward such moving objects. (7) Dust carpets thoroughly with Hellebore or Pyrethrum, close the room for an hour or two, then sweep the floor well and burn the sweepings. (8) Take up and beat carpet, and scrub floors with water containing three to five per cent. Creolin or Carbolic Acid.
	Flies,	(1) Thoroughly and frequently clean stables and all places containing material in which flies breed and the young live. (2) Properly screen all windows and doors. (3) Use sticky fly paper and poisoned fly paper in those parts of the room that are most lighted, especially windows. (4) Dust the infested room well with insect powder and within an hour sweep the room and burn the dust. (5) Fumigate the infested rooms or the buildings, as mentioned above for other household pests.
	Mosquitoes,	(1) Watch carefully for their breeding places, and drain all pools in which the young wrigglers live; fill post holes and hollow stumps containing water, empty all old cans, barrels and other vessels that contain water to support the larvæ or wrigglers of mosquitoes, and especially watch rain-water barrels. (2) Put common Kerosene oil or lamp oil on ponds, etc., in proportion of one teaspoonful to a square yard of water. Use this especially on water in cisterns and rain-water barrels and on ponds and ditches that can not be drained. (3) Introduce minnows into ponds, ditches rain-water barrels and cisterns where the young wrigglers live. Of course, these will not thrive in water covered with oil. (4) Screen windows and doors, and also chimneys and holes for stove pipes. It is not infrequent that they get into a room through windows or ventilating shafts.
	Larder Beetles,	For Larder Beetles and their larvæ or "moths" that feed upon dried meats, smoked meats, etc., brush the meat well to get rid of the pests and enclose it in tightly tied paper sacks.
	Roaches,	(1) For roaches or cockroaches use Powdered borax, Plaster of Paris and powdered sugar, Hellebore, or poison bait, and keep the room as dry and clean as possible, keeping all paste, flour and crumbs cleaned up so that these pests can not feed upon them. (2) Spray the cracks they infest with Corrosive Sublimate in Alcohol.
Lawn Insects,	White Grub,	(1) Kill the May Beetles or June Bugs as they fly around lights by using lantern traps and by such other means as may be possible. (2) Inject Carbon Bisulphide into the infested soil. We have correspondents who have done this with perfect success.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Cut Worms,	Use poison traps and board traps.
Live stock pests,	Flies,	(1) Keep flies from live stock by spraying every day or two with Fish Oil, 100 parts; Oil of Tar, 50 parts; Crude Carbolic Acid, 1 part. Mix or shake these well together and apply as a spray or mist. (2) Clean up all places where flies breed and keep all cleanings from the stables in the field where it is needed for fertilizer instead of in the barn where it is useless and a menace to health and comfort.
	Lice,	Animals infested with Lice should be washed with three per cent. Creclin in water, or rubbed with Kerosene Emulsion, or Carbolic Emulsion, or Carbolic Soap and water applied with a brush.
	Bots,	(1) Clip the hairs on the front legs and parts of the horse that can be reached by its teeth, and also under the chin and throat where the bot fly deposits its eggs. (2) After the horse is attacked by the bots entering the stomach use the ordinary remedy for this trouble.
	Bots in Head of Sheep,	Smear the sides of troughs where sheep are to be salted with tar in order that the sheep will have tar on their noses and keep the sheep-head bot-fly from laying its eggs in the nostrils.
	For Flies in Stable,	Screen stables with large mesh netting one-fourth inch square and keep the building darkened excepting from one side. Flies will pass out through these large meshes, but will not enter the stable through them. This method of affording comfort to horses and cattle is used considerably and successfully in the southern part of Europe.
	Sheep Ticks,	(1) Dust insect powder freely into the wool. (2) Or better, dip the sheep shortly after shearing, and especially dip the lambs at this time into either dilute Kerosene Emulsion or two per cent. Creolin. The latter is better. Every person who keeps sheep should dip the lambs at this time of year to kill the pest, as they pass from the sheared sheep to the lambs.
	Scab of Sheep or Cattle,	Spray or wash with Carbolic Emulsion and thoroughly wash or spray the interior of buildings, floors, etc., with this material or Crude Carbolic Acid, dilute.
	Lice on Cattle, Hogs and Other Animals.	Spray or wash with a three per cent. Solution of Creolin.
Locust trees,	Bag Worms,	(1) Pick the large conspicuous bags from the trees by hand when the leaves are off. (2) Spray with arsenites when the eggs hatch in early spring. (3) Repeat arsenical sprays at any time during the summer when they are feeding on the leaves.
	Borers,	For borers in locust trees which are the most terrible pests of these valuable trees paint the trunks of the trees each spring with pure White Lead and Linseed Oil until the trees reach fair size.
	Leaf-eaters,	Whenever leaf-eating insects of any kind are seen, spray with arsenical poisons.
Maple Trees,	Aphis or Plant Louse,	(1) Spray whenever they are seen with Kerosene Emulsion, Kerosene Mixture, or Soap Solution. (2) Destroy the leaves that fall at mid-summer, carrying the aphis with them. (3) Spray with strong contact insecticides just as the buds are bursting in the spring.
	Cottony Maple Scale,	(1) Spray with Kerosene Emulsion, or Kerosene Mixture, or Carbolic Emulsion, or other contact insecticides early in June. (2) Repeat this whenever such pests are seen.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Lecanium or Turtle-shell Soft Scale.	Same treatment as for Cottony Maple Scale whenever the pests are seen alive.
	Tussock Moth, ...	(See treatment for this pest under "Elm.")
Nursery Stock, ...	Fungus Diseases, ...	(1) Spray with Bordeaux Mixture as the buds are bursting. (2) Repeat this as often as is necessary to keep the mixture on the leaves.
	Chewing Insects, ...	(1) Spray with Paris Green or other arsenites whenever such insects are seen. (2) Repeat such spray if all are not killed wihin a day of two.
	Sucking Insects, ...	(a) When the trees are dormant: (1) Kerosene Mixture or Emulsion at least twenty per cent. (2) Whale Oil Soap, one pound in two gallons of water. (3) One of the Lime-Sulphur Washes or Kerosene Lime. (b) When trees are in leaf: (1) Dilute Kerosene Applications or Soap Solutions whenever living insects are seen. (2) For San José Scale and similar pests repeat this once each week for four or five weeks. (3) For Scurfy Scale and Oyster-shell Scale spray with one of these insecticides the latter part of May and again the latter part of July.
Oats, ...	Smut, ...	(1) Put the seed oats into sacks so they can be pushed under water, and immerse them in Formalin or a solution of Corrosive Sublimate, and then spread and dry. (2) Sprinkle the oats well on the floor with Formalin and water. (3) Soak the seed five to ten minutes in water at one hundred and thirty-three degrees F.
	Rust, ...	No good treatment is known for rust. Have the soil in good condition, use an abundance of manure or fertilizer, and sow at a time when the seed will sprout quickly.
Onion, ...	Maggot or Root Worm, ...	(1) Rotate Crops or grow the onions at some distance from the place where they were the previous year. (2) Use the same treatment as for the Cabbage Root Maggot. (3) Pour a quart of Kerosene into a common bucket full of sand, stir it well, and place a handful of this sand around each plant before the fly has laid its eggs.
	Mildew, ...	(1) Burn the tops and other unused parts of plants as early as possible. (2) Rotate crops. (3) Spray early with Potassium Sulphide and repeat when needed.
	Smut, ...	(1) Burn all possible material in the fall. (2) Treat the seed with Formalin or Corrosive Sublimate. (3) Start onions by sowing the seed in soil that is not infested and transplant them to the place where they are to mature. This is the best and most modern method in onion production as it saves the great labor of weeding and thinning.
Osage Orange, ...	Borers, ...	Cut off and burn the old stalks as new ones will be formed soon.
	San José Scale, ...	Same treatment as given for this pest under Apple.
Pea, ...	Pea Louse or Aphis, ...	Brush the vine on the dry hot soil at mid-day, using pine boughs with the needles or pins on them, and follow this at once with the cultivator; or brush into pans made for the purpose containing water and Kerosene and drawn between the rows, or spray with Kerosene Emulsion, or Whale Oil Soap, or any other good contact insecticide. Plant only in rows so this work can be done.
	Caterpillars or Leaf-eating Insects.	Spray with arsenites whenever anything is found eating the leaves.
	Weevil, ...	Give same treatment as for Weevil of Bean.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
Peach and Nectarine, ..	Borer of Peach, ...	(1) Wrap the trunk with some material that the moth will not penetrate to lay her eggs. (2) Make a mound of earth at least a foot high around the trunk of the tree about June 1st, and remove this in September. (3) Keep a quantity of ashes, or lime around the base of each tree close to the trunk. (4) Treat the infested tree by pouring on a solution of Lye, Soda or Potash. (5) Cut out borers already in the trees if you do not wish to use remedy No. 4, but if remedy No. 4 is used it is not necessary to cut out the borers, as they will be killed and remain under the bark. Of these remedies the following are preventive or used to keep the borer from entering the peach tree: 1, 2 and 3. Remedies 4 and 5 are to kill the borer after it has entered.
	Black Peach Aphis, ...	(1) Spray with Kerosene Emulsion or Whale Oil Soap shortly after the buds burst, or whenever the pest is seen and use remedies recommended elsewhere for Aphis. (2) When the pest is in the roots use an abundance of refuse tobacco, or powdered tobacco in the soil on the roots, or fumigate with Carbon Bisulphide.
	Brown Rot, ...	(1) Spray with Copper Sulphate before the buds open. (2) Use Bordeaux mixture before the flowers appear. (3) Repeat No 2 at least once every two weeks, or often enough to keep the Bordeaux Mixture on the leaves and young shoots until after the latter is half-grown. After the fruit is nearly grown spray at least once a week with Cupram to avoid staining the fruit.
	Curculio, ...	See treatment of this pest under "Plum."
	Peach-leaf Curl, ...	(1) Spray with one of the Lime-sulphur Mixtures before the buds burst in the spring: or spray with strong Copper Sulphate at that time. (2) Spray with Bordeaux Mixture enough to keep the mixture on the leaves until they are half-grown.
	Peach Rosette and Yellows,	No good remedy is known. Pull and burn the diseased trees.
	San José Scale, ...	(See discussion under "Apple.")
	Yellows, ...	No remedy is known. Dig out and burn all diseased trees, and also remove and burn their roots.
Pear, ...	Borers, ...	(See discussion of these pests under "Apple.")
	Codling Moth, ...	(See discussion of Codling Moth under "Apple.")
	Fire Blight or Twig Blight,	Cut off and burn all blighted parts, cutting at least a foot below the diseased places. Paint the stumps and sterilize the mass occasionally by dipping into turpentine.
	Leaf Blight, Fruit Spot or Fruit Splitting.	(1) Spray with Cupram, or strong Copper Sulphate while the leaves are unfolding. (2) Use Bordeaux just before the blossoms open. (3) Repeat the spray with Bordeaux after the fruit has set and as frequently as is necessary to keep this material on leaves and fruit.
	Leaf Mite of Pear, ...	(1) Spray in winter with Kerosene Emulsion or Kerosene Mixture (25 per cent.) (2) Spray the trees at any time when dormant with one of the Lime-sulphur Washes, exactly as for San José Scale.
	Pear Midge, ...	(1) Apply one thousand pounds of Kainit to the acre to the ground beneath the trees about the middle of June. (2) Or work an abundance of powdered tobacco into the soil about this time.
	Pear Psylla, ...	(1) Spray the entire tree thoroughly when the leaves are off with either Crude Petroleum, or strong Kerosene Mixture, or Lime-sulphur Wash. (2) Spray with Whale Oil Soap, one pound to one gallon of water in April. (3) Spray with regular contact insecticides as

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
		for Plant Lice if the young Psylla or Jumping Plant Louse is seen upon the leaves or fruit at any time during spring or summer, and repeat the operation while the pest remain.
	San José Scale, ...	Same treatment as for this pest under "Apple," excepting that upon Pear pure Crude Petroleum can be used whenever the leaves are off, and on Pear and Apple much stronger application of all materials can be made at any and all times than upon Peach or Plum.
	Scab, ...	Same treatment as for "Apple Scab."
	Slug, ...	Same treatment as for "Cherry Slug."
Plum, ...	Black Knot, ...	() Spray with Lime-sulphur Wash or any of the Lime-sulphur Washes when the leaves are off. (2) Cut off the branches that contain knot and burn them, cutting at least six inches below the diseased spot, and dipping the knife blade into turpentine occasionally to sterilize it. Wash the cut part with a good paint. Do not fail to burn the knots that are cut off and let none grow anywhere upon the premises. Induce all neighbors to take the same precaution and watch wild or uncultivated plum and cherry trees to see that the knots do not develop upon them and produce spores to infect other trees.
	Borers, ...	Same treatment as for Borers in "Apple."
	Brown Rot or Ripe Rot, ...	Give same treatment as for Brown Rot of "Peach." Permit no rotten plums or peaches to remain on the trees and dry or become "mummies" to carry the disease spores over winter, and destroy rotten fruit as it falls to the ground.
	Curculio, ...	(1) Spray with Paris Green or Arsenate of Lead just after the buds burst and before the flowers open. (2) Spray again with Arsenate of Lead or Arsenate of Lime soon after the petals fall. (3) Catch the insects by jarring them on cloths or catchers spread for them while it is cool at night or in the morning. (4) Gather and destroy fallen plums every day during the part of the year when the larvæ are in them. (5) Cultivate the plum orchard or whatever ground is infested with Curculio about the middle of July when they are in the pupal state in the soil. (6) In thinning plums, peaches and other fruits select and pick off those that bear marks of the Curculio. (7) Keep poultry in the orchards where these insects are liable to occur.
	Lecanium or Plum Scale, ..	(1) Spray with Lime-sulphur Washes after the leaves fall. (2) Or spray with Kerosene Mixture or Kerosene Emulsion when the leaves are off. (3) Repeat No. 1 or 2 in the spring before the buds burst. (4) Spray with a mild contact insecticide during the summer when these pests are seen. (5) Paint the bark of infested branches with thick soap solution at any time the scales are found upon them.
	Leaf Blight, Shot-hole Fungus, Etc.	(1) Spray with Copper Sulphate or Iron Sulphate and Sulphuric Acid before the buds burst. (2) Spray with Bordeaux Mixture when the leaves first appear. Repeat No. 2 after the fruit has set and every two or three weeks or as often as is necessary to keep the Bordeaux Mixture on the trees and fruit until the latter is three-fourths grown. (3) After this use Cupram every week or two. Note that this is exactly the remedy for Brown Rot and practically all other diseases of leaves and fruit of nearly all plants here mentioned.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	San José Scale, ...	Same treatment for this pest under "Apple." Remember the Plum is slightly more hardy than Peach and can stand a little stronger mixture if necessary.
	Slug, ...	(See remedy for "Cherry Slug.")
Poplar, ...	Caterpillars or Larvæ Eating the Leaves.	Spray with arsenites whenever any pests are seen devouring the foliage.
	Oyster-shell Scale, ...	(See treatment for this pest under "Apple.")
Potatoes, ...	Beetle or Colorado Potato Bug.	(1) Spray with arsenite whenever the insects are seen. (2) Or spray with a combined insecticide and fungicide after the middle of July for both the insects and the late blight or rot.
	Blister or Old-fashioned Potato Bugs.	(1) Spray as soon as they are seen with Arsenite of Lime or Arsenate of Lead. (2) Whip them into straw between the rows and burn the straw.
	Early Blight and Leaf Spot.	Spray with Bordeaux Mixture before the plants are half-grown and repeat this as often as is necessary to keep the material on the leaves.
	Late Blight and Mildew, ..	It is the Late Blight that strikes down the stem and causes potato rot. Spray with Bordeaux Mixture from the middle of July until the vines are nearly ripe, repeating once in two weeks or as often as it is washed off the leaves.
	Potato Rot, ...	Prevent the Late Blight by spraying with Bordeaux Mixture from the middle of July until the end of the growing season, or as often as is necessary to keep this material on the leaves. (2) If the blight should appear, mow or pull the blighted vines before the disease can strike down to the tuber.
	Flea Beetles, ...	These are small flea-like insects, generally dark in color that eat holes in the leaves while they are young. Spray early with Bordeaux Mixture, and an arsenite added, and keep this on the leaves. This will take the place of all other spraying, as the Bordeaux Mixture is a fungicide to prevent the various diseases of the potato and the arsenite is an insecticide to kill the other insects as well as this.
	Scab, ...	Soak seed potatoes in Corrosive Sublimate or Formalin, according to directions given in our Bulletins, and plant in soil that has not had the scab. It is necessary to avoid contaminated soil, even though the potatoes may be treated, and the germs adhering to them thus destroyed.
	Stalk-borer, ...	Gather and burn all stalks or vines immediately after gathering the crop.
Poultry, ...	Gapes, ...	(1) Keep young poultry from eating earth worms by (a) keeping them on board floors, (b) keeping them on gravel, or (c) using lime in abundance in the poultry yard to keep earth worms from coming to the surface of the soil. (2) Feed diseased chicks with corn meal containing turpentine in proportion of one teaspoonful to one pint. Shake the turpentine with water in a small bottle to mix it as much as possible and immediately pour it over the corn meal and stir well. (3) Make a horse-hair loop and insert this in the opening of the trachea or windpipe of the chicken, which can be seen at the middle of the base of the tongue, and by twisting and withdrawing it gap worms can be extracted.
	Lice, ...	(1) Lice on larger fowls can be killed by greasing them around the neck and head with lard or other grease, and especially rubbing this beneath the wing. Smaller chicks are relieved by using the large greased wings of the hens that brood them. (2) Dust the fowls well with Flowers of Sulphur, holding them by the feet and shaking it into the feathers while they are

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
		held up-side down. (3) Dust them with a mixture of Hellebore, Pyrethrum and Flowers of Sulphur. (4) Supply them with abundant dust baths in which No. 2 or 3 are added.
	Red Mites or Red Lice, ...	(1) Use Sulphur in abundance or grease on the fowls. (2) Spray inside of the poultry house and especially the perches with the boiled Lime-sulphur Wash. (3) Wash the perches frequently with a heavy oil like Crude Petroleum to which a little Creolin is added. Clean the poultry house frequently.
Quince, ...	Borers, ...	Same treatment as for Borers of "Apple."
	Codling Moth, ...	Same treatment as for Codling Moth discussed under "Apple."
	Curculio, ...	Same as for "Plum Curculio."
	Blight, Fire Blight or Twig Blight.	Same treatment as "Blight of Pear."
	Leaf Blight, ...	(1) Bordeaux Mixture before the flower buds open. (2) Repeat this when fruit is set and as often thereafter as is necessary to keep the mixture on the leaves. (3) Spray with Cupram after the fruit is full size.
Raspberry, Blackberry. Dewberry.	Anthracnose or Canker of Stem.	(1) Cut out and burn all badly diseased vines. (2) Spray with Copper Sulphate before the leaves appear. (3) Spray with Bordeaux Mixture after the buds burst and repeat as often as is necessary to keep the mixture on the leaves until the fruit is two-thirds grown. (4) Cut and burn diseased vines immediately after gathering fruit.
	Orange Rust, ...	Cut out and burn all diseased plants, removing them by the roots and burning all parts. There is no remedy. Watch for the plants with conspicuous orange rust on the leaves, whether they be wild or cultivated and have them destroyed.
	Tree Cricket, ...	When the leaves are off, look for twigs pierced by the tree cricket in laying their eggs, and cut and burn them.
	Saw Fly or Slug, ...	(1) Spray with an arsenite, when the first leaves have expanded or the insect appears, and repeat in a few days or whenever the pests are seen. (2) Or dust with Hellebore or Air-slaked Lime and Paris Green.
Rose, ...	**Aphis and Leaf Hoppers,** ..	Spray with Kerosene Emulsion or Kerosene Mixture, or strong soap suds, or Tobacco Decoction whenever the pests are present, and repeat within a day if any remain alive.
	Black Spot, ...	From the time the leaves appear spray once per week with Cupram.
	Rose Bugs, ...	(1) Pick by hand and destroy. (2) Shake the bushes over cloths or sheets spread for the pests. (3) Cover the bushes with nets, especially at night. (4) Spray with Arsenate of Lead or Arsenite of Lime.
	Mildew, ...	(1) Spray with Cupram, or with Potassium Sulphide. (2) Fumigate greenhouses with Sulphur for Mildew.
	Red Spider, ...	Syringe with forceful jets of water or spray with Potassium Sulphide, or with Kerosene Emulsion and Sulphur.
	Rust, ...	(1) Destroy all diseased parts. (2) Gather and burn all dead leaves as fast as they are ready to fall. (3) Spray with Cupram (1) as soon as the leaves open, and once in two weeks thereafter.
	Slugs, ...	Give same treatment as for "Cherry Slug" and "Slug of Raspberry."
Strawberry, ...	Aphis on Roots, ...	Set clean plants upon land which did not grow strawberries or melons the previous year. Fumigate plants before setting them in order to kill the root lice, or dip them into Tobacco Decoction or Kerosene Emulsion. Plow under badly infested strawberry beds, and do not plant them in melons or corn.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Leaf Blight,	Spray with Bordeaux Mixture when the leaves first open in the spring, and repeat this just before the blossoms appear. Mow the strawberry bed as soon as the fruit is gathered, throw leaves together in a row between the plants and burn them.
	Leaf Roller,	Mow and burn as for "Leaf Blight."
	Saw Fly,	(See "Saw Fly" under "Raspberry.")
	Weevil,	No good remedy known. Pick off and burn drooping flower stalks and select and plant those varieties that are known as perfect, avoiding the purely staminate varieties.
Tomato,	Corn Worm and Cut Worm,	(See under "Corn.")
	Flee Beetle,	(See under "Potato.")
	Leaf Blight,	Spray with Bordeaux Mixture as for Early Blight of Potato.
	Potato Beetle,	(See under "Potato.")
	Rot,	Spray with Bordeaux Mixture as for Leaf Blight.
	Tomato Worm or Horn worm.	(1) Pick by hand and destroy. (2) Or spray with Paris Green or other arsenite if needed at any time before the fruit begins to ripen.
Violets,	Blight,	Spray with Bordeaux Mixture when first signs of disease are seen and repeat as generally directed for Bordeaux. Remove and burn affected leaves.
	Mildew,	Spray with Potassium Sulphide.
	Red Spider,	Same treatment as for Red Spider on "Rose."
Wheat,	Aphis or Wheat Plant Louse.	If sufficiently abundant spray with Tobacco Decoction, Soap Solution or Oil Emulsion, using a small or knapsack sprayer.
	Hessian Fly,	(1) Plow down infested stubble. (2) Or burn infested stubble. (3) Plant a trap strip during the early part of August along the side of the field that is to be planted in wheat. Plow this trap strip under during the second week of September, and plant the main crop after September 20th for the northern part of the State, 25th, for the central part, and 30th for the southern part. (See our Special Bulletin on "Hessian Fly.")
	Smut,	Treat seed wheat with Corrosive Sublimate or Formalin.
	Wheat Midge,	(1) Plow deep soon after harvest. (2) Be careful to burn or feed all cleanings at threshing time.
	Wheat-head Army Worm,..	Preserve the small snakes, turtles and birds, especially Wrens and Bluebirds. Kill the Army Worms by spraying with arsenical poison when they are quite young, and also when few in numbers, if possible. After the Army Worm has started to march destroy it by one of the following means: (1) Spray vegetation along the front line of its march with arsenical poisons. (2) Spray the worms themselves with strong contact poisons such as very strong soap solution, strong tobacco decoction, crude petroleum, kerosene, or kerosene emulsion or mixture. (3) Plow a strip of ground immediately in front of their line of march and keep the harrow moving over it. (4) Plow a double furrow just in front of them, and by means of a horse drag a log back and forth in this furrow. (5) Plow a furrow with the steep or vertical side from the worms and toward the crop to be protected and dig a number of holes like post holes at intervals in this furrow. The worms will be unable to ascend the vertical side and in crawling along the furrow will drop into the post holes and die. (6) Plow a furrow and put in it a stream of tar or crude petroleum. (7) Plow and cultivate the ground to destroy them after they enter the soil, about midsummer.

PARASITES OF SCALE INSECTS.

The most noticeable feature of insect pests is their abundance in numbers or outbreaks during some years and their apparent absence during other years. Were insect pests to increase without check for five years the earth would be by no means inhabitable. Very few persons comprehend the cause of the sudden disappearance of insect pests and its significance to the agriculturists. However, this is generally due to parasites or adverse climatic conditions, for the most cases are due to the development in great numbers of parasites or beneficial insects which destroy the obnoxious species.

The parasites of insects may be grouped as (1) predaceous insects, or those that capture and feed upon others, among which are the Ground Beetles, the Robber-flies, the Bedbug-Hunter and many others; (2) the external parasites which live upon the body of the host while it yet exists, such as the Bee Louse, and (3) the internal parasites which develop from eggs laid by the mature insect, either upon or in the body of the host or pest, and which during their larval or immature stages feed upon the tissues of the host, avoiding the really essential or vital organs, and thus not producing immediate death. The parasitized insect or host may have enough vitality to complete its own growth, but it dies before transforming to the mature stage, and consequently before laying its eggs and reproducing its kind.

The internal parasites are, of course, remarkably small, and generally have no common names, but many are often regarded as gnats. They multiply rapidly when their hosts are abundant, and soon result in effectually suppressing insect outbreaks.

On account of the great numbers of the internal parasites in the larger scale insects, such as the Oyster-shell Scale, the Scurfy Scale and the Turtle-shell or Lecanium Scale, these common and long-known pests are held in subjection and rarely become, for any considerable length of time, so numerous as to be of serious consequence. Where such pests develop in great numbers there the parasites, chiefly of the internal species, may be seen multiplying. It is not uncommon for us to receive at this office specimens of Oyster-shell, Scurfy and Lecanium or Turtle-shell Scale Insects that are punctured by fine holes, looking as though needles had been put through them. These holes were made by the parasites, which fed in them, came to maturity, emerged and flew away, seeking other scale insects in which to deposit their eggs. We have observed a

definite example in the Maple trees along the streets of the city of York, which were infested with Oyster-shell Scale, but saved by the agency of the internal parasites of that pest.

Among the scale insects sent to this office was a species of Lecanium on Mulberry, our specimen No. 788, sent by Mr. F. C. Stokes, of Philadelphia, Pa., which was kept in one of our breeding cages for the purpose of obtaining the parasites which were puncturing it. From this particular specimen of scale insect, shown slightly enlarged in Plate IV, lower left corner, there eventually appeared two species of these very small parasites, which are also shown in Plate IV, magnified thirty diameters. These have no common names, but Figure a is known by the scientific name *Coccophagus immaculatus* Howard, and Figures b and c are known by the scientific name *Pachyneuron micans* Howard.

We have also bred the last-named species from Lecanium on Jersey Scrub Pine (*Pinus inops*).

The former of this species of beneficial insect is known to be an enemy of the Wheat Aphis and also of the Aphis injuring grass.

Plate V, Figure A, shows another species of these internal parasites (*Physcus varicornis* Howard), magnified sixty-five diameters, which we developed from Scurfy Scale (*Chionaspis furfura*), attacking *Pyrus japonica*. This is from our specimen No. 5211 a, contributed by the Zoological Society of Philadelphia. It is thus seen that most scale insects are parasitized and held in check by their minute enemies, and this is why they have not been so permanently destructive as has the San José Scale. The last-named pest is so very small that these minute parasites, as little as they are, do not find within its body enough substance to bring them to maturity, and consequently it is almost free from internal parasites and not held in check by the agencies that cause nearly all other of our insect pests to come and go in outbreaks such as are often seen.

Plate V, Figure B, shows a common predaceous insect, a Lace-wing (*Chrysopa oculata*) and its eggs on their tall stalk, and also its cocoon or resting stage, magnified two diameters. The larva of this Lace-wing is one of the most beneficial insects, because it is an important enemy of young scale insects and plant lice.

POTATO BLIGHT AND ROT.

It should be remembered that the first spraying for Potato Blight which produces the rotting of the tuber should be made about the last of June. For good results and to prevent Potato Rot certain facts should be remembered. There are two kinds of Potato Blight,

one known as the Early Blight appearing about the middle or last of June, and the other known as the Late Blight appearing during July and August. Both are definite disease conditions of plants due only to disease germs, which enter the tissues of the plant through the leaf or tender part of the stem, and cause it to break down or die and turn brown or dark.

The Early Blight does not produce or result in the rotting of the tuber or potato, although it does a great deal of damage by destroying the plants before the potato is grown. It does not appear to be held in check as readily by Bordeaux Mixture as is the Late Blight, although it is well worth while to spray for both. It should be remembered that in spraying for these, as for other plant diseases, the fungicide is applied as a preventive and, therefore, should be put on the plants before the diseased condition appears, and kept upon them constantly, so that when the disease germs fall on the leaves and start to develop their very delicate and tender substance comes into contact with the fungicide and their vitality is destroyed.

It is now definitely known that Potato Rot is due to or follows the Late Blight. The blight germs enter the leaves which become dark and wither, and this blighted condition extends down the stem and into the tuber. It may rot in the field or the germs may remain in it until it is taken into the barn or cellar and rot there. The best preventive is to spray for Late Blight beginning not later than the last of June, using the Bordeaux Mixture, and applying this at least once every two weeks and repeat after every rain that is hard enough to wash it off the leaves. The object is to keep a very thin film of the Bordeaux Mixture over the leaves all the time, so that the blight germs can not fall upon them without coming into contact with this fungicide and being killed in the process of their development.

It is best to do the spraying with a field sprayer attachment, which means a horizontal pipe extending over the rows, with the pipes reaching down to the potato vines and with one or two nozzles, and permitting the liquid to come as a spray on each side of the row. The pipes can be arranged in such a manner that four or five rows can be sprayed at one time. The best apparatus for the work is an outfit geared with wheels in such a way that the power is generated by driving along. This wheel gearing is especially suitable for spraying trees, excepting where they are very small. The reason for this is that in spraying trees the apparatus stands still and the power runs down to such an extent as to do poor work or become useless, without driving for the purpose of increasing the pressure, while in spraying field crops the power is generated regularly by the turning of the wheels, and the pressure is steady in forcing the liquid through the nozzles in a regular uniform spray.

If a field spraying outfit be not available it is possible to do first class work in a potato field by spraying with an ordinary barrel spray pump, such as is used for orchard work. This can be mounted on a cart or on a wagon in such a way that the pipes and nozzles may extend down over the rows, and the power for the spraying can be produced in the regular way by a man at the handle of the pump.

Make the Bordeaux Mixture by using four pounds of Bluestone and six pounds of Lime in fifty gallons of water. Dissolve the Bluestone in a wooden vessel or merely suspend it in a bag at the top of a barrel of water during the night. If it is thrown to the bottom of the barrel it will not dissolve nearly as readily as to suspend it near the surface of the water. Do not use a metal vessel for dissolving or carrying the Bluestone solution. Slake the Lime and add water to make a milk of Lime, then strain it through a fine strainer, the same as for San José Scale spraying, and pour the Lime water into the dilute Bluestone solution, and this is the Bordeaux Mixture, made by the four-six formula. If Potato Beetles or other chewing insects be present they can be killed by adding one-half pound of Paris Green to every fifty gallons of this mixture. Add Paris Green to any liquid by putting it into a small vessel like a tin can or bowl, and add enough water to make it mushy when well stirred, and stir it until it is made into a paste, then rinse it into the liquid, and it will be carried through all parts. If it be added dry to a barrel of liquid, it is quite difficult to get it to enter into the liquid itself, as it will persist in remaining on top in the form of small dry lumps. It is not necessary to add Paris Green to the Bordeaux Mixture, excepting when chewing insects are present or liable to appear soon. If Arsenate of Lead be preferred or more convenient, it will be found an excellent poison, and will stick better in solution than will Paris Green, and should be used at the rate of two pounds to fifty gallons of water or Bordeaux Mixture.

There is no doubt whatever of the possibility of properly controlling and preventing the Late Blight and Rot of Potatoes by spraying regularly with the Bordeaux Mixture. One correspondent has written to this office that by comparison of the yields of sprayed and unsprayed portions of his large potato field, he found that he has saved one hundred and sixteen dollars ($116.00) worth of Potatoes per acre by spraying for this disease.

SPECIMENS RECEIVED DURING MAY 1907.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9010	(a) Scurfy Scale,, (b) San José Scale,	1	C. C. Haldeman, Danboro.
9011	Stone Flies (Pteronarchys regalis),	1	G. R. Styer, Berwick.
9012	Oyster-shell Scale,	1	I. C. Gahagan, Smicksburg.
9013	Rose Scale,	1	J. E. Patterson, Wilkes-Barre.
9014	(a) Katydid Eggs,	1	I. C. Elder, Chambersburg.
9015	Oyster-shell Scale,	1	J. Mosier, Saegerstown.
9018	Oyster-shell Scale,	2	R. Felty, Onset.
9019	Giant Water Bug (B. griseus),	2	G. W. Gelwicks, Rutherford.
9022	(a) Cecropia Cocoons, (b) Promethea Cocoons,	2	G. VanNieda, Womelsdorf.
9023	Oyster-shell Scale,	2	S. E. Firth, Lansing.
9025	(a) Lecaniodiaspis tessellata, (b) Sesiid larvæ,	2	M. M. Haines, Cheltenham.
9026	Oyster-shell Scale,	2	E. Welles, Wilkes-Barre.
9030	Insects,	3	H. W. Anderson, Stewartstown.
9031	Stone Fly (P. regalis),	3	Mrs. G. P. West, Danville.
9036	Oyster-shell Scale,	3	G. R. Pritchard, Harrisburg.
9038	Terrapin Scale (E. nigrofasciatum),	4	A. M. Yingling, Altoona.
9040	Giant Water Bug,	4	H. Z. Wampole, Telford.
9043	San José Scale,	4	A. S. Smith, Everett.
9051	Biting Louse,	6	Isaac DeWalt, Allentown.
9052	Oyster-shell Scale,	6	W. E. S. Uber, Clark's Mills.
9053	Water Beetle,	6	H. Schick, Camp Hill.
9056	Oyster-shell Scale,	6	A. R. Greenwalt, Kempton.
9062	Beetle (Anatis ocellata var.),	7	D. W. Bohn, Robesonia.
9063	Eyed Elater (A. oculatus),	7	P. V. James, Philadelphia.
9064	San José Scale,	7	J. H. Patterson, Athens.
9066	Scurfy Scale,	8	J. R. Sleek, New Paris.
9068	Long-horned Beetle (Monohammus titillator),	8	E. J. Nisley, Penbrook.
9070	Oyster-shell Scale,	8	F. Keith, Eagle Foundry.
9071	(a) Rose Scale, (b) Oyster-shell Scale,	8	C. F. Hays, Curwensville.
9072	(a) Oleander Scale (Aspidiotus hederæ), (b) Cecropia Cocoon,	8	J. E. Patterson, Wilkes-Barre.
9073	Oyster-shell Scale,	8	E. Welles, Wilkes-Barre.
9074	Oyster-shell Scale,	8	B. F. Rinehart, West Moshannon.
9076	(a) Scurfy Scale,	8	Dr. W. B. Cathcart, Mt. Pleasant.
9078	Syrphid Fly Pupa,	8	E. Stoner, Ephrata.
9080	Lecaniodiaspis tessellata,	9	F. W. Floyd, Dillsburg.
9084	Polyphemus Cocoon,	9	C. F. Sander, Millersville.
9093	Wireworm,	10	H. S. Webb, Scranton.
9094	Water Scavenger Beetle (Hydrophilus triangularis),	10	Miss I. Dunkle, Harrisburg.
9095	H. triangularis,	10	H. Barrington, Harrisburg.
9097	San José Scale,	10	E. D. Swartz, Markelsville.
9098	(a) Buffalo Carpet Beetle (Anthrenus scrophulariæ, (b) Clothes Moth tubes,	10	Miss M. Blackford, Freeport.
9101	(a) Giant Water Bug, (b) Water Beetle (Dytiscus fasciventris),	10	C. N. Greene, Troy.
9106	Oyster-shell Scale,	11	N. L. Keirn, Hastings.
9107	Diptera larvæ Prob. Anthomidæ,	11	Miss B. M. Kimball, Westfield.
9108	Oyster-shell Scale,	11	H. W. Frey, Oil City.
9110	Insects,	13	G. R. Pritchard, Harrisburg.
9117	(b) Scurfy Scale,	13	J. W. Ipher, Benton.
9118	Oyster-shell Scale,	13	L. P. Kerner, St. Marys.
9120	H. triangularis,	13	W. K. Warden, Oxford.
9123	Roach Egg Case,	13	A. I. Root Co., Medina, O.
9134	(a) Cicada Egg Punctures, (c) Psyllidæ on Sumac,	14	J. W. Fryling, Sunbury.
9135	Oyster-shell Scale,	14	S. C. Snyder, New Millport.
9137	Scurfy Scale,	14	C. H. Smith, Cove Forge.
9138	Oyster-shell Scale,	14	W. P. Fraser, Pittsburg.
9139	Oyster-shell Scale,	14	F. W. Boyer, Pottsville.
9140	(a) San José Scale, (b) Twice-stabbed Lady Beetle (Chilocorus bivulnerus),	14	G. A. Hoagland, Bedford.
9145	Plum Scale (Eulecanium prunastri),	15	J. H. Moyer, Muncy.
9146	Giant Water Bug,	13	T. E. Moore, Grampian.
9147	San José Scale,	15	W. C. Baird, Ashtabula, O.
9148	Oyster-shell Scale,	15	Capt. S. Martin, Erie.
9149	Insects,	15	W. H. McElwee, Harrisburg.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9153	Giant Water Bug,	17	J. H. Sherk, Fredericksburg.
9159	Oyster-shell Scale,	17	N. J. Wells, Tunkhannock.
9161	San José Scale,	17	H. K. Miller, Huntsdale.
9164	(a) Wasp (b) Sesiid Pupa,	18	G. R. Pritchard, Harrisburg.
9166	(c) Sphinx Pupa,	18	R. L. Jackson, McConnellsburg.
9167	(a) Giant Water Bug, (b) H. triangularis,	18	A. J. Rice, Easton.
9168	(c) Giant Water Bug,	18	H. Schick, Camp Hill.
9172	Ox Warble larvæ,	20	I. DeWalt, Allentown.
9174	Clothes Moth,	20	H. E. Weithnecht, Siegfried.
9182	Aphids,	20	S. T. Davis, Lancaster.
9183	Oyster-shell Scale,	20	W. L. McCracken, Brookville.
9184	(a) Oyster-shell Scale,	20	W. D. B. Ainey, Montrose.
9185	(a) Scurfy Scale,	20	Oberlin Bros., Rochester Mills.
9187	Chrysomelid Beetles,	20	A. Deming, Lawrenceville.
9188	(a) San José Scale,	20	A. M. S. Hamilton, Cochranville.
9190	Scurfy Scale,	20	C. C. Bowman, Pittsburg.
9191	(a) June Bug (Lachnosterna sp.), (b) Scurfy Scale,	20	L. M. Kerlin, Liverpool.
9202	Giant Water Bug,	21	F. S. Henry, Philadelphia.
9203	San José Scale,	21	H. Justice, Philadelphia.
9204	Beetle (Ips 4-guttatus),	21	W. H. VanFleet, Factoryville.
9207	(a) Lady Beetle (Megilla maculata), (b) Saw Fly,	21	P. S. Tooker, Easton.
9209	Work of Beetles Prob. Cerambycidæ.	22	L. Kraemer, Reading.
9212	Terrapin Scale (E. nigrofasciatum),	22	W. R. Crabbe, Pittsburg.
9215	(a) Coleoptera pupæ, (b) Ground Beetle Scarites sp.,	22	W. H. MacElwee, Harrisburg.
9221	American Roach (Pripianeta americana,),	23	A. I. Root, Medina, O.
9227	(a) Oyster-shell Scale,	27	F. W. Sheldon, Susquehanna.
9231	(a) Cecidomyia Larva,	27	C. J. Rich, Woolrich.
9232	Aphids,	27	H. H. Plank, York Springs.
9233	Cecropia Cocoon,	27	J. E. Patterson, Wilkes-Barre.
9235	(a) Saw-toothed Meal Beetle (Sylvanus surinamensis), (b) Coleoptera, (c) Biting Louse,	27	C. A. Row, Langhorne.
9236	(a) Tiger Beetle (Cicindela 6-guttata), (b) Noctuid Pupa,	27	W. C. Dickson, Wayne.
9239	San José Scale,	27	A. H. Sinsabaugh, Wyalusing.
9244	(a) Psyllidæ. (b) Crane Flies,	28	J. W. Fryling, Sunbury.
9246	Clover Weevil (Phytonomus punctatus)	28	J. H. Klase, Snydertown.
9247	Round-headed Apple Borer,	28	D. M. Wertz, Quincy.
9252	Lachnosterna sp.,	29	M. Siglin, Broadheadsville.
9255	Insects,	29	G. R. Pritchard, Harrisburg.
9259	Aphids,	31	E. Peters, Carlisle.
9263	Flower Beetle (Euphoria inda),	31	N. E. Miller, New Mayville.
	Invertebrates not Insects.		
9028	Mite,	3	The Patriot, Harrisburg.
9092	Earth Worm,	10	W. L. Hostler, Bellwood.
9127	Tick,	13	J. F. Griesemer, Stonersville.
9149	(a) Millipede,	15	W. H. McElwee, Harrisburg.
9173	Millipede,	20	F. W. Matz, Mohnton.
9184	(b) Mites,	20	W. D. B. Ainey, Montrose.
9185	(b) Mites,	20	Oberlin Bros., Rochester Mills.
9227	(b) Mites,	27	F. W. Sheldon, Susquehanna.
9231	(b) Mite Eggs (?),	27	C. H. Rich, Woolrich.
9235	(d) Mites, (e) Pseudiscorpion,	27	C. A. Row, Langhorne.
9255	(e) Red Mites,	29	G. R. Pritchard, Harrisburg.
9257	Leech,	31	F. L. Witherup, Emlenton.
	Reptiles, Batrachians and Fishes.		
9004	Red-bellied Snake (S. occupitomaculata),	1	J. Jackson, Huntingdon.
9005	Blacksnake (B. constrictor),	1	Biss B. VanSant, George School.
9006	Common Garter Snake,	1	R. F. Miller, Frankford.
9007	(a) Blacksnake,	1	J. D. Richard, Barton.
9008	(a) 3 Sculptured Turtles (Clemmys insculptus), (b) Common Garter Snake, (c) Green Frog (Rana clamitans), (d) 3 Leopard Frog (Rana pipiens)...	1	R. W. Wehrle, Indiana.
9016	Common lizzard (Sceloporus undulatus),	2	L. B. Small, Marion.
9020	Grass Snake (L. vernalis),	2	J. F. Beecher, Kerrsville.
9021	Common Garter Snake,	2	C. Bruckart, Lititz.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9024	Ribbon Snake (T. sauritus),	2	L. S. Pearson, Wayne.
9032	Blowing Viper (H. platirhinos),	3	J. S. Landis, McCulloch's Mills.
9033	Common Box Tortoise (Terrapene carolina),	3	A. G. Wanner, Ephrata.
9035	Ground Snake (C. amoenus) 3 —, —		
9059	(a) 2 Speckled Turtles (Clemmys guttatus),	7	C. L. Gruber, Kutztown.
9060	(a) Common Box Tortoise, (b) 3 Hellbenders (Cryptobranchus alleganiensis), (c) Water Dog (Necturus maculosus), (e) 5 Green Frogs (Rana Clamitans) (f) 3 Leopard Frogs,	7	R. W. Wehrle, Indiana.
9061	Frog Eggs,	7	F. W. Hagenbuch, Danville.
9065	(a) 3 Rock Snakes (S. dekayi),	8	B. Ditzel, Harrisburg.
9079	(b) 4 Brown Salamanders (Desmognathus fusca),	9	J. T. Black, Glenhope.
9081	Queen Snake (R. leberis),	9	R. W. Wehrle, Indiana.
9087	(a) House Snake (L. d. triangulus),	10	W. L. Mosebey, Wells Tannery.
9088	Common Garter Snake,	10	G. M. Lehman, Essington.
9089	(a) Red Salamander (Spelerpes ruber), (b) 2 Granite Salamanders (Plethodon glutinosus),	10	W. F. Dague, Mont Alto.
9090	(a) 2 Common Box Tortoises,	10	P. S. Tooker, Easton.
9103	Common Water Snake (N. sipedon),	10	A. Shelly, Harrisburg.
9105	(a) Red Salamander, (b) 2 Brown Salamanders, (c) Meadow Frog (Rana palustris),	11	W. H. Bullock, Honesdale.
9111	Blowing Viper,	13	W. E. Vallerchamp, Duncannon.
9112	Common Garter Snake,	13	I. F. Zook, Ronks.
9114	House Snake,	13	M. M. Haines, Cheltenham.
9115	(a) Grass Snake, (b) Rock Snake, (c) 2 Green Frogs, (d) 12 Newts (Diemictylus viridescens),	13	F. B. Keboch, Williamstown.
9126	(a) 2 Red Salamanders, (b) Brown Salamander,	13	State Museum, Harrisburg.
9128	Rock Snake,	14	A. Hartwick, Harrisburg.
9129	House Snake,	14	E. E. Steizerwalt, Bowmanstown.
9131	(a) Common Garter Snake, (b) Ribbon Snake,	14	H. A. Brightbill, Jr., Marsh Run.
9132	Common Lizard,	14	J. C. Suskey, Harrisburg.
9133	4 Common Lizards,	14	W. L. Mesebey, Wells Tannery.
9141	(a) Common Garter Snake, (b) Brown Salamander, (c) Sculptured Turtle,	14	H. L. Meredith, Harrisburg.
9143	(b) 3 Common Garter Snakes,	15	R. W. Wehrle, Indiana.
9144	(a) 4 Rock Snakes, (b) 1 Common Garter Snake, (c) 1 Common Water Snake,	15	R. F. Miller, Philadelphia.
9151	House Snake,	16	C. A. Palmer, Warfordsburg.
9154	House Snake,	17	C. A. Palmer, Warfordsburg.
9155	Black Snake,	17	R. W. Wehrle, Indiana.
9157	King Snake (Lampropeltis getulus sayi),	17	J. Hand, Jr., Belleplain, N. J.
9166	(a) 2 Green Frogs, (b) 1 Meadow Frog, (d) Miller's thumb (Cottus gracilis?),	18	R. L. Jackson, McConnellsburg.
9168	(a) Green Frog,	18	H. Schick, Camp Hill.
9175	Grass Snake,	20	Dr. O. W. H. Glover, Laurelton.
9176	Common Water Snake,	20	J. B. Richard, Barto.
9192	Rock Snake,	21	R. Beistline, Harrisburg.
9193	(a) Green Frog, (b) Common Box Tortoise, (c) Copperhead Snake (A. contortrix), (d) Pilot Snake (C. obsoletus),	21	R. W. Wehrle, Indiana.
9194	Common Garter Snake,	21	G. W. Wimmer, Nazareth.
9195	(a) Purple Salamander (Gyrinophilus porphyriticus), (d) 2 Brown Salamanders,	21	R. I. Myers, Welty.
9196	(a) Common Water Snake, (b) Black Snake,	21	S. B. Harstine, Ferndale.
9197	(a) Common Water Snake, (b) Common Garter Snake,	21	D. M. Hovis, New Franklin.
9198	House Snake,	21	H. A. Brightbill, Marsh Run.
9199	Speckled Turtle,	21	W. C. Dickson, Wayne.
9208	(a) 2 House Snakes, (b) Common Lizard,	22	G. and Mc. Landis, McCulloch's Mills.
9213	Common Garter Snake,	22	R. D. Spencer, Williamsport.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9217	(a) Rock Snake, (b) 2 Sculptured Turtles, (c) Red Salamander, (d) 2 Granite Salamanders, (e) 6 Green Frogs,	22	F. D. Keboch, Williamstown.
9220	(a) Spotted Salamander (Amblystoma punctatum), (b) Wood Frog (Rana sylvatica),	23	C. T. Settlemyer, Wilmore.
9226	(a) 4 Pickering Frogs (Hyla pickeringi), (b) 14 Green Frogs, (c) 4 Leopard Frogs,	25	R. W. Wehrle, Indiana.
9230	Rock Snake,	27	R. M. Adams, Lancaster.
9237	Common Water Snake,	27	R. W. Wehrle, Indiana.
9240	Common Garter Snake,	27	C. Buckart, Lititz.
9241	House Snake,	27	F. E. Taylor, Waynesboro.
9242	House Snake,	27	R. Stansfield, Emaus.
9243	(a) 2 Common Lizards,	28	H. R. VanOstrand, Crafton.
9256	Hellbender,	31	W. H. Shatto, West Fairview.
9258	(a) Queen Snake, (b) Leopard Frog,	31	L. W. Wehrle, Indiana.
	Birds and Mammals.		
9008	(e) Red-tailed Hawk,	1	R. W. Wehrle, Indiana.
9017	Brown Bat (Vespertilio fuscus),	2	W. Franklin, Harrisburg.
9027	Crow,	2	J. B. Richard, Barto.
9046	2 Crows,	6	J. C. Stoops, Karns City.
9047	Flicker,	6	E. A. Wilcox, Sugar Run.
9067	Yellow Warbler,	8	Mrs. J. Waugh, Washington.
9079	(a) Sharp-shined Hawk,	9	J. T. Black, Glenhope.
9087	(b) Jumping Mouse (Zapus hudsonius),	10	W. L. Bosebey, Wells Tannery.
9113	2 Blue Jays,	13	J. B. Richard, Barto.
9116	Brown Bat,	13	P. Nissley & A. Hartwick, Harrisburg.
9117	(a) Sparrow Hawk,	13	H. W. Ipher, Benton.
9124	American Bittern,	13	Jacob Mell, Jr., Richland.
9125	Ruby-throated Hummingbird,	13	D. B. Milliken, Landisburg.
9130	Kingfisher,	14	R. J. Hull, Lisburn.
9131	(c) Jumping Mouse (Z. hudsonius),	14	H. A. Brightbill, Jr., Marsh Run.
9156	Maryland Yellow-throat,	17	Miss G. Brion, Okome.
9163	Oven Bird,	17	H. Schick, Camp Hill.
9177	Red-shouldered Hawk,	20	C. L. Woodcock, Raymond.
9181	Oven Bird,	20	B. M. Stone, Stull.
9211	Meadow Lark,	22	C. E. Denniston, Okome.
9218	Oven Bird,	23	C. L. Brumbaugh, Wilkinsburg.
9224	Yellow Warbler,	24	R. W. Wehrle, Indiana.
9225	English Sparrow,	24	Mrs. G. P. West, Danville.
9238	Broad-winged Hawk,	27	D. P. Krone, Lewisberry.
9253	Yellow-bellied Flycatcher,	29	Mrs. D. M. Braillier, Conemaugh.

THE

ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

SUBJECTS:

Study of Insects: Homoptera. Economic Entomology. Robins.

VOL. V, No. 3.

July 1, 1907.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR JULY, 1907.

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Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

CONTENTS OF THE JULY ISSUE.

OUR MONTHLY CHAT WITH READERS.

* * * Re-organization of the Office Force of the Division of Zoology.—The Economic Zoologist takes pleasure in announcing to the public the present organization of his office corps of helpers, for it is upon the energy and faithfulness of these that we must depend for successful results.

The present Assistant Economic Zoologist is Mr. A. F. Satterthwait, of Chester county, who has had practical experience upon the farm and scientific training in the Philadelphia Academy of Sciences and also in the Pennsylvania State College. The present Clerk is Mr. W. R. McConnell, of Indiana, Pa., who was graduated from the Pennsylvania State College in 1906, and taught Zoology and kindred subjects in that institution during the past year. The Chief Stenographer is Miss Kathryn P. First, of Harrisburg, and the Messenger is Mr. J. D. Hipple, of Middletown. In addition to these persons, whose offices are named by legislative enactment, there is a Chief Nursery Inspector, Mr. E. B. Engle, of Waynesboro, and about twenty investigators, inspectors and demonstrators.

* * * Directions for Collecting.—We have received so many requests for re-publishing in one number of our Bulletin, the "Directions for Collecting and Preserving Insects," that we have decided to do this in the September number of this volume. This is particularly justifiable in consideration of the fact that the previously issued Bulletins containing these directions have been exhausted, and teachers and pupils are particularly desirous of making and preserving collections, beginning with the scholastic year.

* * * Turtles and Lizards Wanted.—As readers of these Bulletins know, we have commenced a series of investigations and publications upon the Animal Life of Pennsylvania. The Serpent Bulletin was published in September of last year, and for this publication there has been such a demand that the supply is now exhausted, and we contemplate a Second Report on "The Serpents of Pennsylvania" next year. At the present time, while our efforts are being given chiefly to the Entomology of the State, we are paying some attention to the study of Turtles and Lizards, as two of the Orders of the general Class of Reptiles, and it is our desire to procure enough material at once to make it possible to publish in October of this year a Bulletin upon "The Turtles and Lizards of Pennsylvania." We, therefore, request all persons who can do so to kindly aid by sending us, at once, specimens of these two Orders of Reptiles. We greatly prefer to have them killed, in order that the stomach contents will be preserved and we can determine what they have been eating in their wild state. It is an easy matter to

procure chloroform from almost any drug store, and put this into a tightly closed small vessel with the specimen to be killed. Leave it closed about a half hour, and the animal will be found dead or insensible. If insensible, it can be killed by piercing its brain or heart with a sharp needle, and if Turtles are found difficult to chloroform, an excellent way to treat them is to inject chloroform into their lungs by a hypodermic injection (through the skin) back of the forelegs. Send larger packages by express at our expense, or smaller packages by mail, when postage will be refunded. Please do not send dead animals by mail during warm weather, when they spoil in transit.

As with the Serpent Bulletin, of which the supply is now unfortunately exhausted, and for which requests are daily made in vain, we are obliged to announce that the first copies of the new Turtle and Lizard Bulletin issued from this office, will be mailed to those persons who have aided the work by sending us specimens or notes upon these subjects. After our correspondents and contributors are supplied with their promised Bulletins, the publication will be sent to others requesting it until the supply will have been exhausted, after which time a second edition will not be issued. and other copies will not be available. Consequently the sure way to receive a copy of the forthcoming Bulletin upon the Turtles and Lizards of Pennsylvania is to act upon the above suggestion and send to this office specimens to aid in these studies. They must be sent very soon in order to reach us in time to be useful in the studies which we are now making.

Notes or communications upon Turtles and Lizards are also desired, and will be given the same consideration in regard to the mailing list as specimens sent to us. Any person who desires further directions for collecting, killing or sending specimens is invited to write directly to the office of the Economic Zoologist.

* * * Insects Wanted.—We are working upon a complete Catalog of the Insects of Pennsylvania, with notes on dates and localities of occurrence, food, enemies and economic features and remedies. This is a stupendous task, and the details of the plans are not yet ready for publication, but it is enough to say that several specialists will be associated with us in the preparation of such a Catalog. It may be a year or more until it is completed, and consequently it is not advisable for persons to write now for it, but we make this announcement at this time to invite all interested persons to continue sending specimens of Pennsylvania insects to this office. Every specimen will be acknowledged, properly preserved, identified and used in further studies and publications.

Please address all specimens, notes and inquiries to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

A GENERAL SYSTEMATIC STUDY OF INSECTS—PART III.

In our Monthly Bulletin for January, 1906, Vol. III, No. 9, page 274, we commenced "A General Systematic Study of Insects." In that Bulletin was published a brief discussion of the Arthropoda, or "Joint-footed" Animals, and a fuller treatise of Hexapods or Insects, and the relationship of the three other classes making up the Sub-kingdom. We there published concerning the various Orders of Hexapods, or Insecta, such as the Fish Moths, May Flies, Dragon Flies, Stone Flies, White Ants, Book Lice, Bird Lice, Earwigs, and Orthoptera or so-called "Straight-winged" Insects. The last Order was concluded on page 292. This subject was resumed in Vol. IV, No. 2, for June, 1906, page 48, giving a preliminary discussion of the Order Hemiptera or Bugs, and completing the study of the Sub-order Heteroptera or "True Bugs," on page 72 of Vol. IV.

As was shown on page 49, the Order Hemiptera includes three Sub-orders, which are to be recognized by the following analytic key:

A. Hemiptera with or without wings, but with jointed beak.

B. First pair of wings thickened at the base, with thinner extremities, which overlap flat on the back; beak arising from the front part of the head. Sub-order A. Heteroptera. The True Bugs, p. 49.

BB. Wings all thin and transparent (of the same thickness throughout) and usually sloping at the sides of the body; beak arising from the hinder part of the lower side of the head. Sub-order B. Homoptera. Cicadas, Plant Lice, Scale Insects, etc.

AA. Wingless Hemiptera, with fleshy jointed beak, parasitic upon man and other mammals. Sub-order C. Parasitica. The Lice.

Sub-order D. Homoptera. The Cicadas, Leaf-hoppers, Aphids, Scale Insects, etc.

The insects of this Sub-order vary greatly in form and appearance, but all live on the juices of plants, sucking them with the sharp beak or proboscis, and consequently all are injurious to vegetation. One species is important as an article of commerce, this being the Cochineal Scale Insect, of Mexico, which is collected by scraping it from the cactus plants which it infests, and is dried and sold without any further preparation. It is used as a red coloring matter for cakes, candies, etc.

The beak of the Homoptera is attached to the hinder edge of the lower side of the head, and although these insects do not all have wings, nearly all which do possess them, hold them sloping like the

roof of a house when at rest, and the upper or front wings are of equal thickness, or the same texture, from base to tip. In this way they are to be distinguished from the representatives of the Sub-order Heteroptera, discussed in the last Bulletin on this subject. As these are suctorial insects, they are not to be killed by arsenical or other internal poisons, and must be attacked by external applications if at all.

The Homoptera agree with the two other Sub-orders of Hemiptera or Bugs in having incomplete metamorphosis or three distinct stages in their life history, represented by the egg, nymph and adult or mature insect. Thus there is no pupal stage or chrysalid, excepting in the male Scale Insects which represent the peculiar condition of complete metamorphosis or the four stages. The nymphs or young are very much like the parents or adult insects, excepting that they are smaller in size and do not have wings. At first the wing pads are absent, but after molting a few times the little pads or elements of wings are visible, and after further molts the wings appear, and the insect has assumed the adult condition. They are unable to fly excepting in the last-named stage, and when the young or wingless forms are found in numbers on any plant it may be taken as practically certain that they are feeding on this particular kind of plant.

Homoptera further agree with all the other species of Hemiptera or Bugs in having only sucking mouth parts, entirely unfitted for chewing or biting, and they are thus compelled to take their nourishment by piercing the plants and sucking the sap from them. They often inject a liquid or saliva into the plant, which may poison it more or less. Infested leaves often curl and thus form protecting covers within which the pests revel. Of course, being suctorial insects they are to be killed only by contact applications, as they do not commence to take their nourishment until after the bill is inserted into the food plant, and consequently can not be affected by arsenical or other internal poisons, such as are to be sprayed on the surface of leaves and fruit for chewing insects.

Remedies.—The remedies for these sucking insects must necessarily be of a nature to kill by contact and must be included in the oils, soaps, caustic solutions, gases, dusts and decoctions. The internal insecticides, such as those mentioned in the May Bulletin from Formula No. 13 to 22 inclusive will not destroy them. Among the contact applications, Kerosene Emulsion raised until about ten per cent Kerosene is used, will give good results, as will also Kerosene Mixture. Whale Oil Soap, used one pound to six gallons of water, and ordinary laundry soap, one pound dissolved in four gallons of water, are also good. Tobacco Decoction, Formula No. 49, is useful as well as the various powders, such as Hellebore, Pyrethrum and other

good insect powders when fresh and applied either as a dust or decoction. Fumigation with Tobacco is a standard remedy for such pests in greenhouses, while the Hydrocyanic Acid Gas, Formula 35, is one of the best remedies. Sulphur is extensively used in fumigation, as are also the fumes of Pyrethrum and other powders. Of course, fumigation can not be successfully employed excepting where the infested plants can be tightly enclosed in a room, tent or vessel.

Care should be taken to avoid confusing the strength of the winter formula with that of the summer formula, and applying any material so strong as to destroy the foliage by using a remedy that was intended for use in winter or for dormant trees only.

FAMILY 1. Cicadidæ. The Cicadas or Locusts.

Few insects are better known, at least by reputation and reference in stories and Scripture, than the Cicadas or so-called "Locusts," although on the other hand, very few are so little understood and so commonly and unjustly misrepresented.

The insects of this family properly should be known as Cicadas rather than Locusts. The creatures that properly should be called "Locusts" are the "Short-horned Grasshoppers," or Acrididae, discussed on page 288 of Vol. III. Many stories have been told and published concerning Locusts destroying crops, which are based upon the occurrence of this Grasshopper rather than the Cicada, and there is no doubt of the fact that the Locusts in the Scripture, which "came in devouring hordes," were Short-horned Grasshoppers instead of Cicadas. The "Kansas Locust" is also a Grasshopper, and not a Cicada.

As was shown in a previous Bulletin, the Grasshoppers or Acrididae have heavy jaws, and devour a great deal of vegetation, while the Cicadas have only finely pointed beaks, and in most cases never insert them into vegetation nor suck juices, and are entirely unable to devour or eat away any of the tissue of the plant. The Cicadas have large bodies and comparatively small, broad heads, with prominent eyes. The males of some species are capable of producing a remarkably loud, shrill noise, while the females are silent.

The most remarkable thing concerning the Cicadas is their periodicity of appearance. For example, the one commonly seen during the summer time, known as the Dogday Harvest Fly (Cicada tibicen), is the "Two-year Locust." Although they require two years for development, there is a brood each year, and as these overlap it gives to the observer the appearance of an annual brood.

The Seventeen-year Cicada, or so-called Seventeen-year Locust (Tibicen [Cicada] septendecim), appear at regular intervals of seventeen years in the North and sometimes only thirteen years in the South, with such precision that many persons have wondered how the

insects are able to time themselves in the ground with accuracy during the long stay of many years. The life history of the Seventeen-year Locust (Tibicen [Cicada] septendecim) is as follows (See Plate VI.):

wood of some tree, and as the young hatch they drop to the ground, enter it, and feed upon the sap of the roots of trees and bushes. Their growth is, of course, very slow, as is shown by the fact that at the end of five years they are only about the size of a full grain of wheat. During the spring of the seventeenth year they start upward toward the soil, and when the weather is favorable they bore their way out of the ground, and climb the trunks of trees or posts, where they fix themselves firmly with their feet. Next along the back there appears, in the outer hull, a split or cleft, through which the newly winged insect crawls, very soft, white and delicate. After remaining thus a few hours, its wings become strengthened to such an extent that it is able to fly. No one knows just what kind of time-table Nature is able to keep for an insect with such a remarkable development, but the statement that the insect bores down into the ground for eight years, takes one year to turn around, and eight more years to return to the surface of the ground is, of course, quite erroneous, and is merely a crude popular effort to explain the cause of the interval of seventeen years.

After becoming winged they fly and become quite noisy in the trees and bushes. Their noise sounds very much like the croaking of a great many frogs, and we have known it to be mistaken for that of frogs. They lay their eggs in the branches of woody plants, and sometimes also pierce berry bushes, and even weeds or other low plants. The only damage they do to vegetation is at the time they are depositing their eggs, and this is caused by the rasp-like saw with which they tear away the bark of the wood and enter in the branch. This means that, like many other insects, they may take no food whatever after becoming mature or winged.

Although we have made no special effort to compile a full list of the species of plants attacked by the Seventeen-year Cicada, we have recorded thirty-five varieties, as published below, seventeen of which were sent, with specimens, by Mrs. G. P. West, of Bald Top, Pa: Apple, Ash, White Aster, Azalia, Blackberry, Currant, Chestnut, Missouri Currant, Oxeye Daisy, Broad-leaf Dock, Dogbane, Dogwood, Fleabane, Cinque Foil, Germander, Goldenrod, Grass-leafed Goldenrod, Huckleberry, Wild Indigo, Poison Ivy, June Berry, Red Maple, Mullein, Peach, Pear, Ragweed, Sour Gum, St. John's Wortel, Milky Sumac, Timothy, Vibernum, Wild Cherry, Yarrow.

In the adult stage they very rarely even suck juices, and never devour any part of a plant.

Preventives and Remedies.—As a preventive of the injurious ef-

fects of the Seventeen-year Locust, it is best to know their territory and date of occurrence, and in any locality where they are to appear during any summer, avoid planting young trees the year before. The injurious effects of this insect are remarkably noticeable from the fact that its injuries cause the twigs to break, and the leaves turn brown during midsummer, when the branches with such withered leaves hang on the trees and become very conspicuous, and cause the injury to appear really worse than it is. If the trees have been injured, it is best to prune them out in the parts that have been attacked, shaping the tree the best that is possible, but getting rid of the damaged wood. Before the occurrence of the Locusts it is best to anticipate their coming, and leave trees untrimmed during that year, so as to scatter their attacks over different branches, and later prune them, cutting out as many of the injured ones as may be possible, leaving the good branches to form the tops. Covering with netting to protect them can be practiced where there are a few choice trees to be saved, and young trees that are likely to be injured by having their trunks pierced in the process of egg-laying by the insects, may be wrapped around the trunks with some tarred paper or protecting cloth or wood veneer. It is best in planting young orchards to avoid planting during a year or two previous to the date of an outbreak of the seventeen-year locust, at least in a vicinity where trees, orchards, forests, woodlands or bushes are present in which these pests may be feeding on the roots. Ask the older inhabitants about the last date when the "Locusts" came, and count forward seventeen years from that date to ascertain the next date of their appearance.

The stories of our Seventeen-year Cicadas attacking men and beasts are entirely erroneous, and there is no cause whatever to fear these insects, as far as injury to mankind is concerned. Their only injury to vegetation is by piercing or sawing into the branches at the time of laying the eggs, but this may be very severe in young orchards planted near infested woodlands.

Several distinct broods have been traced, catalogued, and named in the United States, and as these are entirely distinct, but the species of insects is the same, they may cause the outward appearance of the Seventeen-year Cicadas at irregular intervals. However, the individuals in any one of these broods are not related to those in another, and they should not be confused. The broods occurring in Pennsylvania are as follows:

Brood VIII appeared in 1889 and 1906, and will also appear in 1923. This was very abundant in the eastern part of the Allegheny Mountain region of this State, and was also found throughout some of the counties further Eastward, such as Berks, Lehigh and Schuylkill. It appeared only in spots, For example, in Centre County there were two acres of a few square miles each in which it was

very abundant, but in other places it was not to be seen in great numbers.

Brood XI occurred in this State last in 1894 and will next appear in 1911, especially along the eastern and southern portions.

Brood XV occurred in 1897 in the western part of Pennsylvania, and will again occur in 1914.

Brood XVIII appeared in 1898 in the northwestern portion, as well as the northern portion of Pennsylvania. and will again occur in 1915.

Brood XX appeared in 1900 in the northwestern and western parts of Pennsylvania, and will again occur in 1917.

Brood XXII appeared in 1902 in Pennsylvania, especially throughout the southern counties, where it did much damage, particularly in Franklin and Adams counties, and will again occur in 1919.

Enemies: The Cicada, being a large and conspicuous insect, has a large number of natural enemies. There is no doubt that skunks, moles, chipmunks, pigs and ground inhabiting insects feed upon the nymphs or young while they are yet in the soil and sucking juices from the roots of trees. The most important period, however, for them to be attacked by their natural enemies is just after they appear above the ground and while their bodies are yet soft and full, and the wings too delicate and flimsy for use. At such times pigs, poultry, birds of nearly all kinds, especially the English Sparrow, and Serpents, Turtles, Chipmunks and Squirrels feed extensively upon them. We have found the stomach of the Copperhead Snake filled with scores of these insects. These pests have afforded at least eight per cent. of the food of the Copperheads which we have dissected, and no less than six specimens, out of forty-one of this reptile, containing food, were found to have fed upon Seventeen-year Cicadas. (See page 188 and Plate XXXVII, of Vol. IV, of the Monthly Bulletin of the Division of Zoology, September, 1906.)

We have also found the Hog-nosed Adder, Spreading Adder or Blowing Viper feeding upon Cicadas. See Vol. IV, p. 184, of this Bulletin.)

This particular subject is discussed in greater length on pages 367 to 377 of Vol. III, Monthly Bulletin of Division of Zoology.

FAMILY II. Fulgoridæ. The Lantern-fly Family.

The common name "Lantern-fly" refers to some of the insects belonging to this Family, although not living in the United States, which are phosphorescent or glow as though provided with lanterns. These are not the Fire-flies or Lightning Bugs, and are not to be confused with them. The Fulgorids which are found in this State are not phosphorescent, and consequently can not be said to carry lanterns.

There are possibly ninety species of this Family to be found in this State, about twenty of which we have in our collection. One of these belongs to the Genus Scolops, and feeds upon the grasses, while another, known to grapegrowers as the Mildew Leaf-hopper, and to entomologists by the scientific name Ormenis septentrionalis, feeds mostly upon wild grape vines, but may also attack a great many cultivated plants. It may occur in local outbreaks in considerable numbers. On June 21, 1905, we saw this in great numbers in Harrisburg, feeding upon the following plants: Apple, Grape, Peach, Currant, Gooseberry, Rose, Boxwood, Southern Tulip tree, Lily of the Valley, Violet, Deutzia, Wiegelia, Ampelopsis or Ivy, Gallingsoga or South American Weed, and other plants. In this particular case it appeared to be most destructive to the Boxwood, but as it was in the immature stage, and consequently without wings and not flying, and found abundantly upon each of the plants named, there is no doubt whatever of its feeding upon all of them.

Remedies.—Where this pest becomes abundant, it can be killed by spraying with about eight per cent. Kerosene Emulsion, or one pound of Whale Oil Soap in six gallons of water, or common soap, one pound in three gallons of water. When it reaches the winged state and flies readily, it is a good plan to spray with one of the above insecticides, made at dilute strength just mentioned, to avoid injuring the foliage, and as soon as the insects fly to the ground spray them again on the ground with an insecticide made two or three times as strong. Also, trap them with tarred cloth, the same as Leaf-hoppers, discussed in this Bulletin.

FAMILY III. Cercopidæ. The Spittle Insects or Frog Hoppers.

As one walks along the edges of woods or through pasture fields during the summer months, he often sees what looks like large drops of froth clinging to the leaves or stems of plants, and looking as though some animal, like a cow, frothing at the mouth, had passed that way and dropped the liquid upon the plant. This mass of buddles, which may be as large as a man's thumb, contains a small light-colored insect, which can be found by spreading it upon a leaf. Sometimes four or five insects may be found in the same mass of foam. Prof. Comstock says: "The froth is supposed to consist of sap, which the insect has pumped from the plant, by means of its beak, and passed through its alimentary canal. It is asserted that these insects undergo all their transformations within this mass; that when one is about to molt for the last time, a clear space is formed about its body; the superficial part of the foam dries, so as to form a vaulted roof to a closed chamber, within which the change of the skin is made. The adult insects wander about on herbage and trees. They have the

power of leaping well. The name 'Frog-hopper' has doubtless grown out of the fact that formerly the froth was called 'frog-spittle,' and was supposed to have been voided by tree-frogs from their mouths. The name is not, however, inappropriate, for the broad and depressed form of our more common species is something like that of a frog." These are to be seen upón the stems and leaves of various kinds of plants with but apparently little regard for the species which furnishes them nourishment.

Remedies.—Fortunately, they rarely become sufficiently abundant to demand treatment, but if they should occur in outbreaks, it is an easy matter to brush off the masses of froth, and spray with a contact insecticide, such as recommended for plant lice or Aphids.

FAMILY IV. Jassidæ. The Leaf-hoppers.

These insects are small in size, but the are often exceedingly abundant in numbers and quite destructive. They are elongate, generally at least three times as long as wide, and are distinguished from those of the next family by their smaller, lower and narrower bodies. They run quickly when young, and hop or jump readily, and fly in zigzag lines as soon as they become adult or winged. They live mostly on the under sides of leaves, generally causing them to assume a grayish appearance when infested.

The remedies for the Leaf-hoppers are contact insecticides, such as Kerosene Emulsion, Soap Solution, or very strong Tobacco Decoction, or Decoction of Pyrethrum or Hellebore. Apply the spray in such a way as to reach the under sides of the leaves. The nymphs or young insects are light in color, and although they run quickly, they do not fly away, and as they are soft-bodied and delicate, they are easily killed by spraying with proper contact insecticides. It is important to spray thoroughly and early. The mature insects fly so readily they often escape the spray liquid as it comes toward them, and even when they get a little of it on their wings, they fly down to the ground and rub off the liquid and return to the plants later. Even though the young should be killed by the spray at such times, the older ones may return to re-infest the plants by laying other eggs. It is best to spray the ground and adjoining plants when the winged insects fly from the plants that are being treated. Especially if they alight upon the ground, it is advisable to apply the spray liquid stronger there, either by having another vessel of stronger solution at hand, or by using the Kerosene Mixture, applied with a Kero-water Sprayer, so arranged that the percentage of Kerosene can be instantly changed by shifting the gauge. For vineyards we would recommend spraying the vines with about eight per cent. Kerosene Mixture, and after the adult insects light upon the ground, go through the row again at once, spraying with

at least fifteen per cent. Kerosene Mixture. Make the increase in strength by shifting the indicator that regulates the amount of Kerosene.

The Grape-vine Leaf-hopper (Erythroneura vitis) is one of the best known pests and one of the most serious enemies of the grape. It is not difficult to hold this in check, however, if the vineyardist will practice a diligent, intelligent use of the spray pump. This insect is too often known as "Thrips" by grape growers, but this is not a "Thrip," as this name belongs to the insects of the Family Thrypidae, Order Physopoda, to be discussed in a subsequent Bulletin.

The Rose Leaf-hopper (Typhlocyba rosæ) is quite familiar to growers of roses, as a little light-colored insect, found infesting the under sides of rose leaves, and causing them to appear spotted with gray on the upper side. As soon as the rose leaves turn gray, it may be suspected that this pest is injuring the same by piercing the leaves from the under side, and they should be sprayed or dipped well into one of the solutions named above. If a spray pump is not at hand, dipping will serve the purpose, or the application can be made very successfully by dipping a whisk broom into the solution and dashing it on the under side of the leaves by striking it against a stick or the hand. The little white specks seen adhering to the under sides of grape leaves are the cast skins of these insects, which are left behind after molting or advancing in the stages of their growth.

As the insects of this Family jump and fly readily, advantage can be taken of this feature of their habits by carrying a screen of cloth or paper covering, coated with Tar or Kerosene, along the leeward side of the plants, and have a person on the windward side to drive them against this oiled screen or tarred board. This principle can be utilized on an extensive scale in a large vineyard by arranging two screens, to be carried on a narrow cart between the rows of the vineyard, and drawn by a horse. The screens should be extended from each side of the cart upward and downward, like a roof on a house, or rather like the roofs of two houses standing side by side, with the cart between them. Let them come down over the vines, and especially be sure that the tarred screen reaches down well over the outside of each row, so as to come near the ground. The horse walking between the rows will help to frighten the pests, making them jump toward the outside against the screen there. If this be not sufficient, brushes can be attached to the harness in such a way as to help drive the Hoppers out against the outer side of the screen.

As the Leaf-hoppers pass the winter in the adult stage, hibernating in leaves, brush, rubbish and loose earth, it is important that all leaves and rubbish be gathered and burned late in the fall after

the pests have gone into their winter quarters, and if possible rake over the loose earth occasionally during the winter to expose the insects to the rigors that would destroy them.

FAMILY V. Membracidæ. The Tree-hoppers.

While the Leaf-hoppers are all small and narrow, the Tree-hoppers, or those belonging to the Family Membracidæ, are larger, sometimes being one-half inch in length, are much taller, and generally have points, spines or knobs somewhere on their bodies. From their large eyes and grotesque appearance, these are truly called the "brownies" of the insect world. They jump and fly readily, and also live by piercing and sucking vegetation. One species, of rather common occurrence, is called the Buffalo Tree-hopper (Ceresa bubalus) from the fact that at the sides of the thorax there are projecting horns, more or less reminding one of the appearance of a Buffalo. This insect is a uniform green color, and is sometimes a pest to apple trees. In depositing its eggs in small crescent-like slits, arranged in rows in the bark, it inflicts some mechanical injury to the twigs. These twigs, showing the egg-punctures of the Leaf-hopper, are sometimes sent to us with the supposition that they contain the San José Scale. Where sufficiently abundant, it is well to spray with contact insecticides, and if the twigs be much injured by egg-punctures cut them out in the fall.

There are two other families of insects, commonly known as Leaf Hoppers, one of these being known by the scientific name Bythoscopidae, and the other as the Tettigonidae. The differences are of a character too technical to admit of discussion in a popular bulletin, but all species belonging to the three families of "Leaf Hoppers" agree in feeding upon vegetation by puncturing the under sides of the leaves and sucking the juices, causing them to become dry and brittle, and most of them pass the winter as adult or mature insects in grass or rubbish, and lay eggs in the spring, from which there comes an early summer generation, which in turn lays eggs to produce a second brood before fall. Wherever they become sufficiently abundant as to demand treatment, these remedies are practically the same, without regard to species, as those mentioned above.

FAMILY VI. Psyllidæ. The Jumping Plant Lice.

These insects are very small, looking like plant lice, and flying readily. From this they are given the common name of "Jumping Plant Lice." They suck the juices from plants, as do other Hemiptera, and may be very destructive during summer seasons, when they appear in great numbers. Some of the Psyllids have the habit of making galls, one of which forms galls on leaves of the

hackberry or Celtis. Plate XII, Fig. 2, shows these Psyllids, which we bred from the Hackberry Leaf Gall, magnified twenty times.

The Pear-tree Psylla (Psylla pyricola) is by all means the most serious pest of this Family represented in this State. It is at times and in some places very destructive to the pear crop of this and adjoining States, and should be watched with great care by pear growers. It sucks the sap from the leaves and twigs, and also from the stems of the fruit. It is often to be found around the petiole of stems of the leaf and also that of the fruit. It passes the winter in the adult stage around the trees, and especially under the edges of loose bark on the trunks, and should be treated by spraying at least once during the winter time with a contact insecticide. It should be sprayed again in the spring after the leaves expand, using Soap Solution or Kerosene Emulsion, and again in midsummer if any of the pests yet be present. A prominent grower of pears in New York reported to us that he had lost many of his pear crops, amounting to thousands of bushels, by this pest, and in the fall, as it was present in great numbers on the trunks of the trees, it appeared that it would pass the winter there and destroy his crop again the next year. However, the White-breasted Nuthatches came to the orchard in numbers, and he encouraged them to remain by fastening pieces of fat meat in his trees, and protected them from molestation. The Nuthatches remained, and fed on the pests all winter, and cleaned up the trees so effectively that he could scarcely find any in the spring. Measures against this pest would be, (1) Protect the insectivorous birds, especially Nuthatches, Chickadees and Warblers; (2) Clean up fallen leaves and burn them late in fall; (3) Spray the trunks and branches of trees with Lime-sulphur or some other contact insecticide (oils or soap) during the winter time; (4) Repeat the spraying of infested trees during the early part of June; (5) Repeat the spraying operation at any time during the summer, when the pests appear in numbers.

There is a species of winged Psocid or Book Louse that looks to the unaided eye very much like the Psylla, but is larger, has longer wings and in structure does not agree with it. In our efforts to locate the Pear-tree Psylla we have obtained from contributors several specimens of this Psocid, which have appeared in such numbers as to cause considerable alarm by their outbreak in the latter part of the summer, but they are really not injurious and need not cause fear.

FAMILY VII. Aphididæ. The Plant Lice or Aphids.

The Plant Lice, or Aphids, "Green Lice," etc., are among the most common of our insect pests. They are likely to attack almost any kind of vegetation, and by sucking the juices they may make de-

formed leaves and cause considerable injury. Of course, they also are sucking insects, the same as are the other members of this Sub-order and Order, and for this fundamental reason poisonous insecticides cannot be used against them. They must be killed with contact applications, if at all.

The Plant Lice are all very small insects, being green, white, brown or red in color. The white ones live in the soil on the roots of plants, and we mostly see the various species of the green kinds. The brown ones are generally found upon the leaves of the peach, plum and cherry. The life history of Plant Lice is one of the most peculiar and marvelous in all Nature. There may be a score or more generations or broods of this insect in one year, or but one which may be produced by bearing living young. They mostly reproduce agamically or by a process known as Parthenogenisis, which means reproduction without mating.

The Plant Lice often change food plants during the year, sometimes passing from one plant to another of an entirely different character. For example, the Hop Louse or Aphis, so destructive to the hop fields of the West, spends part of its time as an enemy of the leaves of the plum. The full peculiar life history of one species of Aphis or Plant Louse is illustrated in that of the Apple Aphis (Aphis mali), which we have worked out originally some years ago. This insect passes the winter in the form of very minute black shiny eggs on the branches of apple trees. In the early spring, about the time the buds are bursting and the green leaves are peeping forth, these eggs hatch and the very young and delicate Plant Lice crawl to the forthcoming green leaves and commence to suck the sap from them and grow. At this time they are so delicate that they are easily killed by a sudden fall of temperature, or even by a cool rain. In only a few days they grow to full size and commence to bear living young at the rate of several per day for many days. The adults or mature insects are wingless and also regarded as sexless. Their young are also wingless, and without mating commence to bear young in a few days, and continue this method of reproduction for generation after generation, until the leaves are thick or tough at midsummer, when a winged generation develops, and flies to the roots of grasses, and there commences to bear young, which feed upon the roots of the grasses from summer until fall, reproducing generation after generation by the agamic process. About the time the fall apples are ripening, the Aphids on the grass roots develop wings and fly to the leaves of the apple tree, where they bring forth one more generation or brood, which this time mates and lays eggs on the twigs of the apple trees. These eggs remain there exposed during the winter and hatch early the next spring, and thus the peculiar life cycle, with its alteration of host or food plant, is completed.

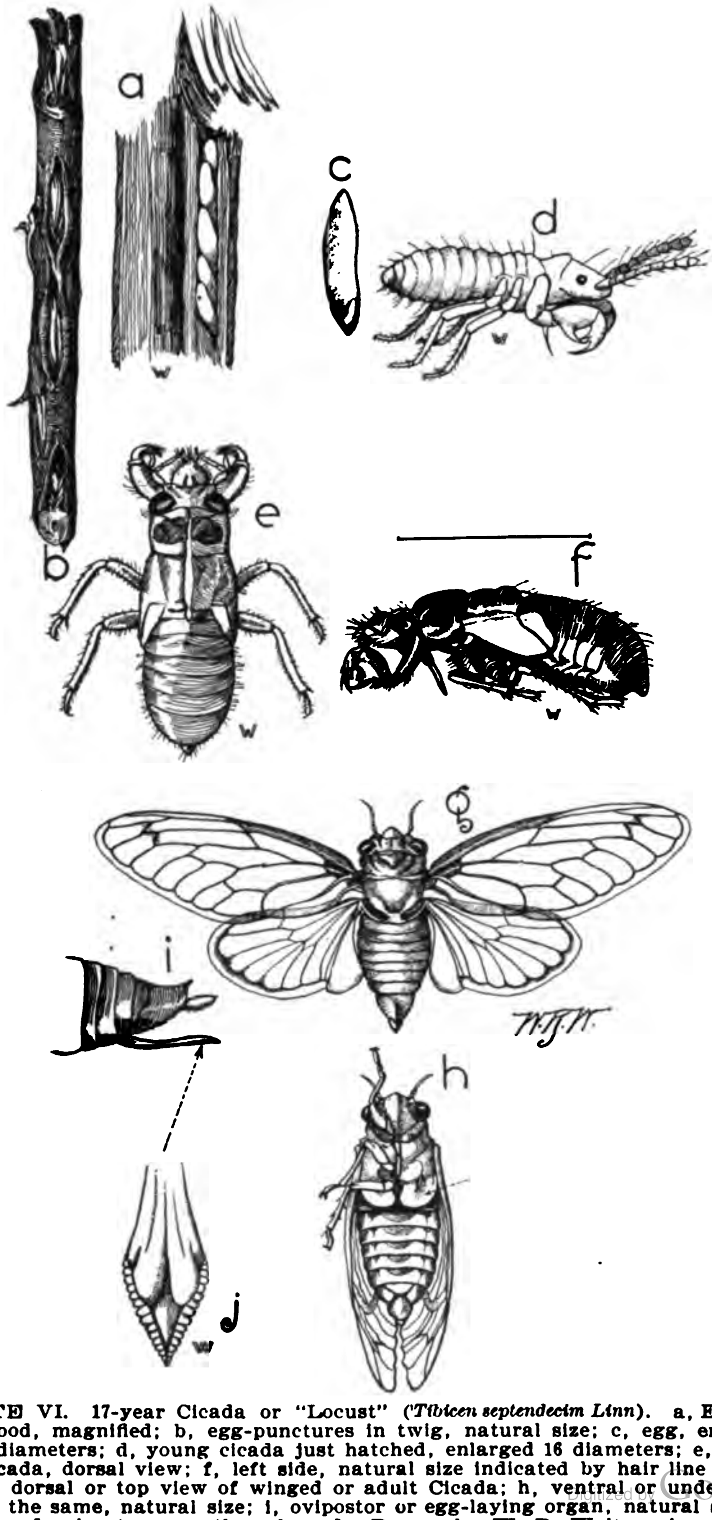

PLATE VI. 17-year Cicada or "Locust" (*Tibicen septendecim Linn*). a, Eggs in wood, magnified; b, egg-punctures in twig, natural size; c, egg, enlarged 9 diameters; d, young cicada just hatched, enlarged 16 diameters; e, young cicada, dorsal view; f, left side, natural size indicated by hair line above; g, dorsal or top view of winged or adult Cicada; h, ventral or under view of the same, natural size; i, ovipostor or egg-laying organ, natural size; j, tip of ovipostor, greatly enlarged. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist.

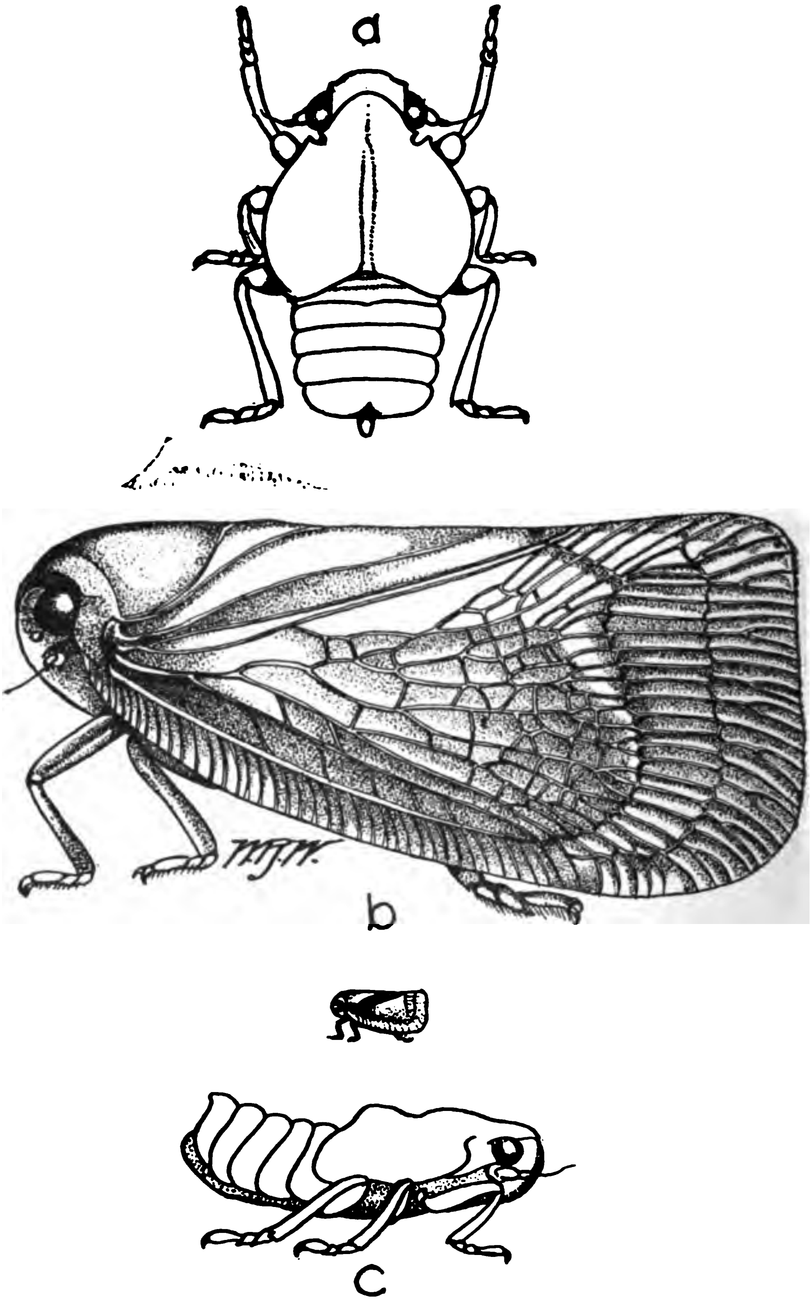

PLATE VII. Mildew Leaf Hopper (*Ormenis septentrionalis Spin*). **a and c, young or nymph, greatly enlarged; b, adult or mature leaf hopper, greatly enlarged.** Standing over outline nearly natural size. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist

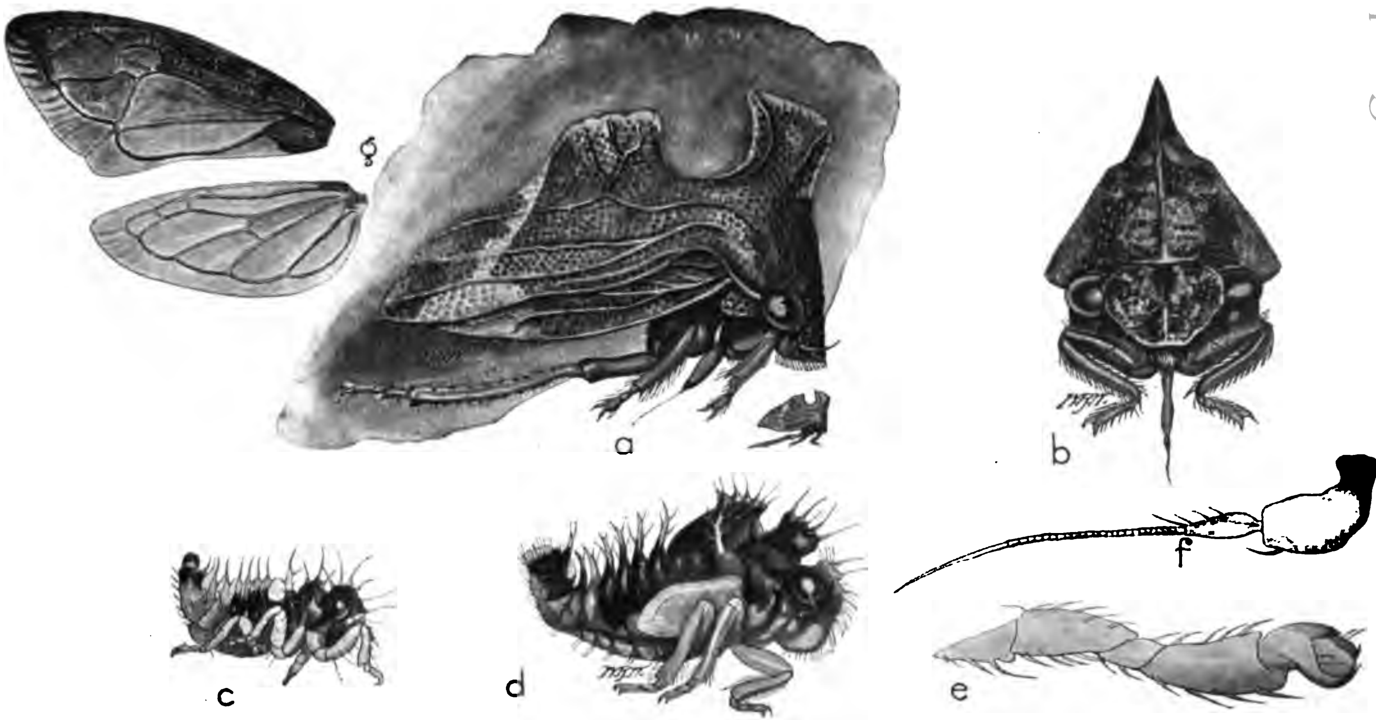

PLATE VIII. Thistle Tree Hopper. (*Entilia sinuata Fabr.*) a, mature or adult insect, lateral view, greatly enlarged, standing over outline of same species, natural size; b, adult or mature insect, front view, greatly enlarged; c, very young nymph; d, older nymph; e, leg and foot of same; f, antennae of same; g, left pair of wings of same. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

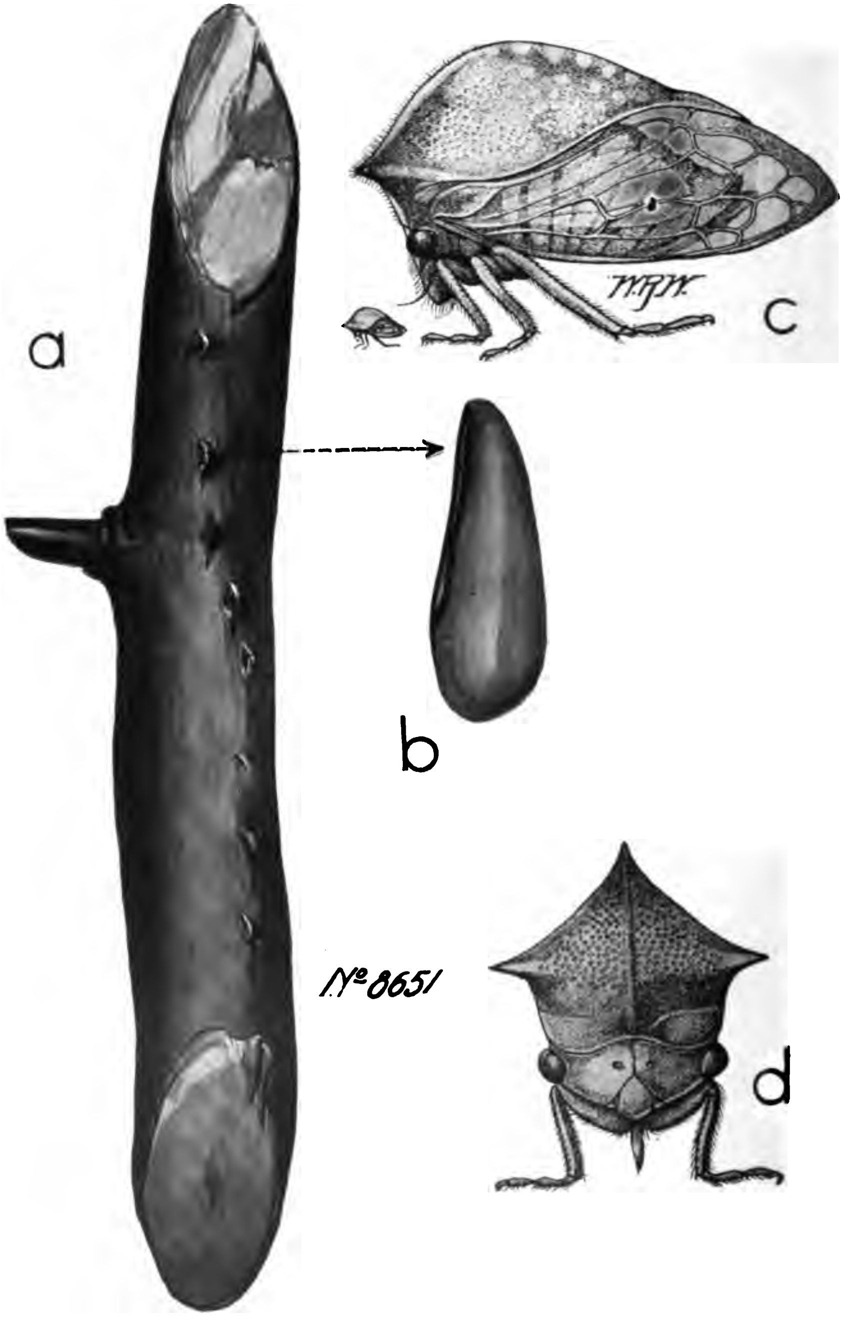

PLATE IX. Buffalo Leaf Hopper. (*Ceresa bubalus Fabr.*) a, twig showing egg punctures in bark, enlarged 2 diameters; b, egg of same, greatly enlarged; c, left side of insect, greatly enlarged, standing over outline figure, natural size; d, front view of same, greatly enlarged. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist.

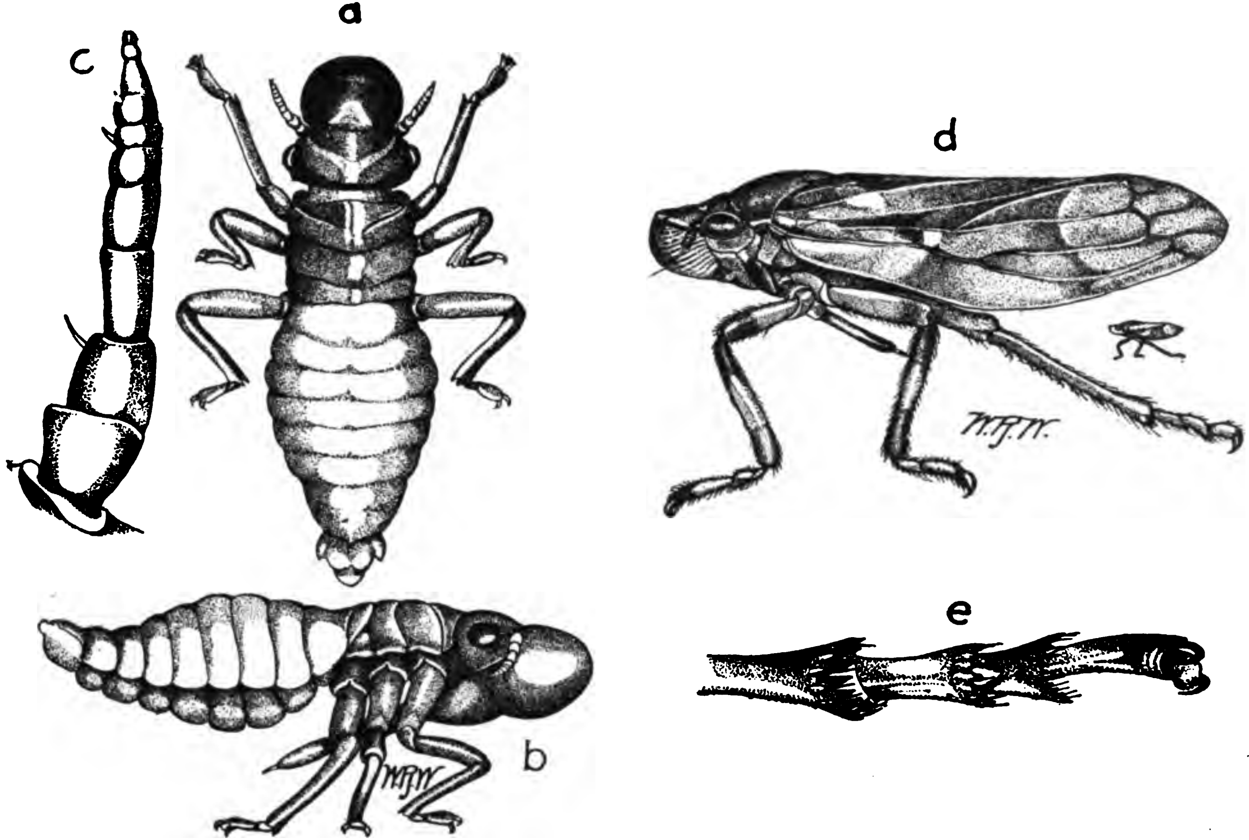

PLATE X. Spittle Insect or Frog Hopper (*Aphrophora parallella* Say.) a, nymph of same, dorsal view, greatly enlarged; b, nymph or young of same, right side, greatly enlarged; c, antenna of same, very greatly enlarged; d, adult or winged form of same, much enlarged and standing over outline figure which is natural size; e, leg of same, greatly enlarged. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist.

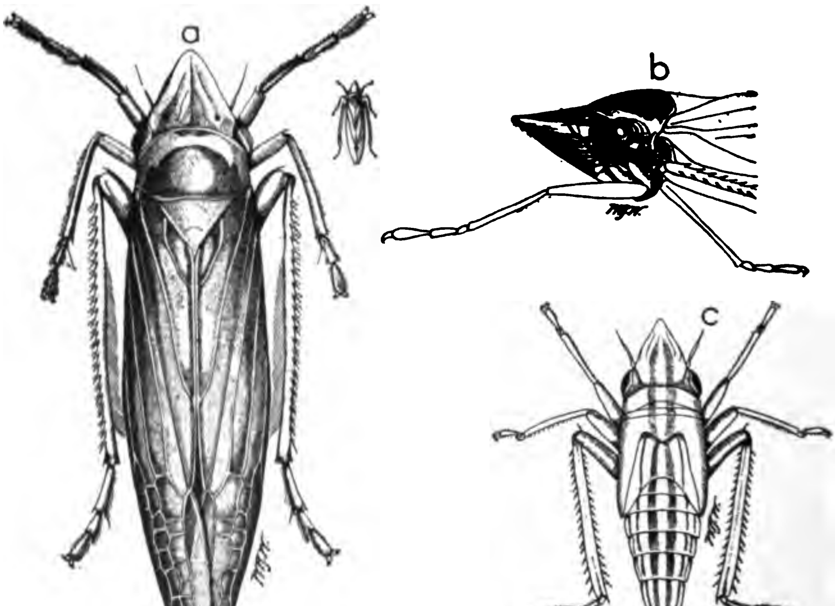

PLATE XI. Grass Leaf Hopper (*Diedrocephala mollipes* Say.) a, adult or mature insect, greatly enlarged, beside an outline drawing showing natural size; b, head of same, greatly enlarged: c, nymph or young of same, greatly enlarged. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

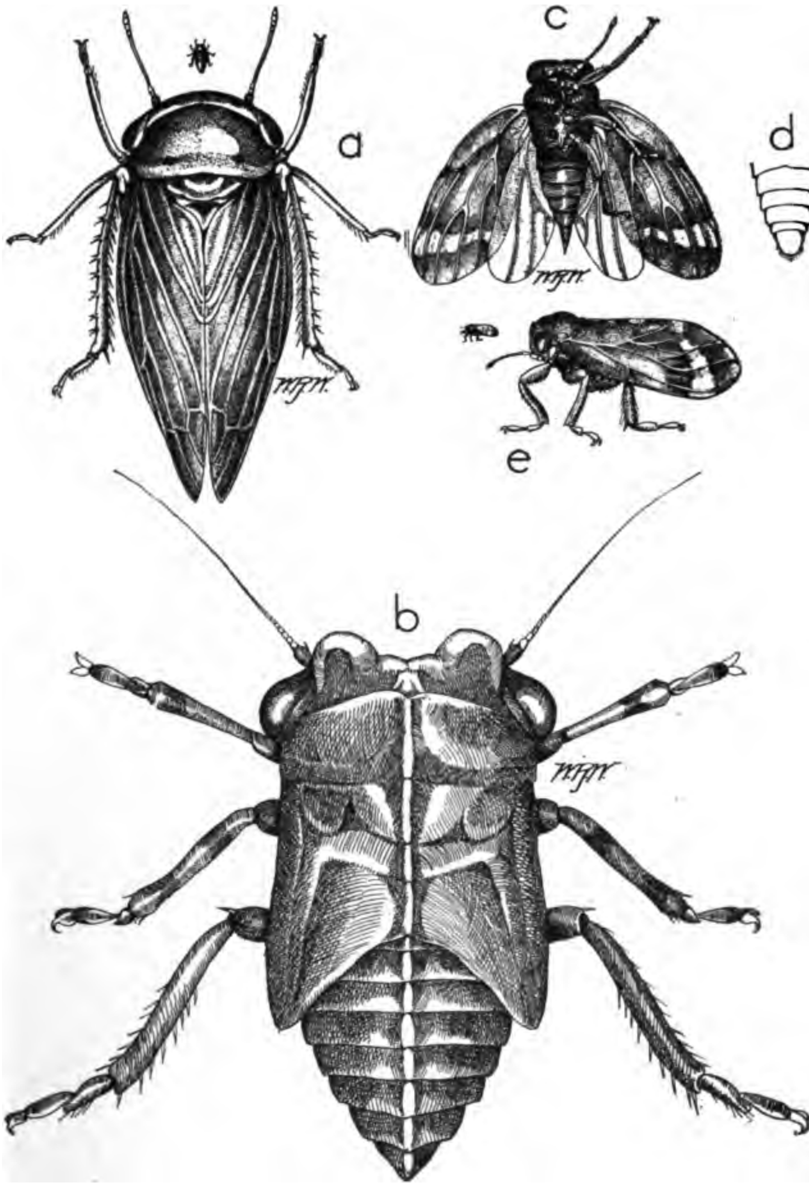

PLATE XII. a and b, 4-Spotted Leaf Hopper *Agallia 4-punctata Prov.* a, adult or mature insect, greatly enlarged, with outline of same, natural size, above; b, nymph or young of same, much more enlarged; c, d, and e, Hackberry Psylla (Psylla sp.) c, adult or mature female insect, showing under side, greatly enlarged; d, tip of abdomen of male, greatly enlarged; e, left side of same, with outline drawing, natural size standing in front. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

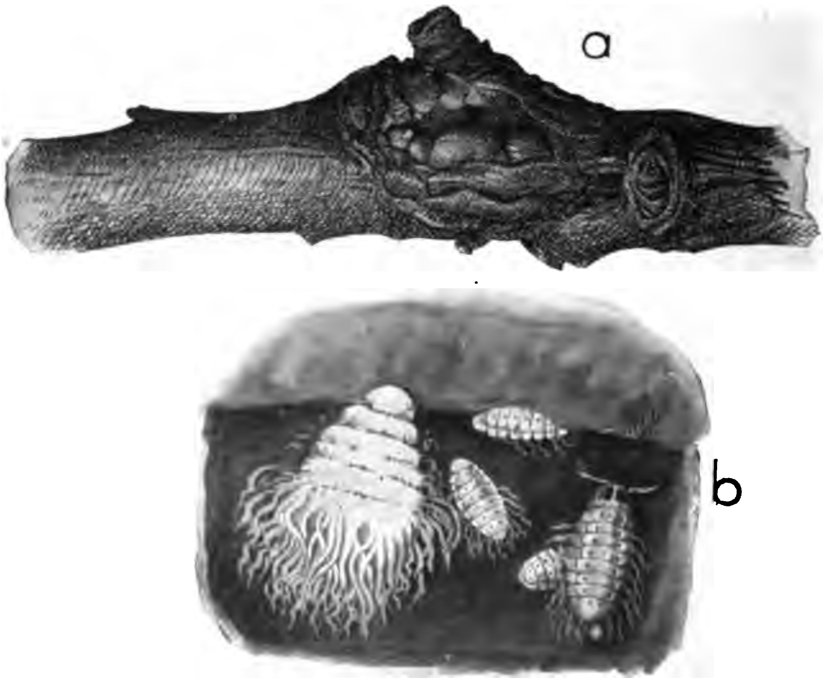

PLATE XIII. Woolly Aphis (*Schizoneura lanigera Hausm.*) a, branch injured by same, natural size, showing spot where this pest chose to work; b, young and old of woolly aphis, greatly enlarged. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

During the spring while they are on the apple tree they are found almost wholly on the under sides of the leaves or at ends of the tender young shoots. Their injuries often cause the leaves to twist out of shape or become badly curled and form pockets or enclosures, which protect them from rain and sun and from some of their natural enemies, such as the birds.

On the trunks of trees that are thus infested, a great many ants can be seen going up and down in lines, and persons often think that the ants are injuring the trees. This is not true, however, for these little insects are going to the Plant Lice to feed on the sweet, clear liquid, which the Aphis secretes, as such insects as Ants, Flies, Bees and Wasps readily partake of this secretion. This liquid is called honey dew, and often drops upon leaves or bushes beneath the trees in such a way and in such a quantity as to make them look as though they are varnished. When Bees are unable to obtain nectar or better food, they sometimes store honey dew in great quantity, but this is not good honey, and should not be sold as such, neither should it be relied upon as winter stores for a colony of Bees.

A black fungus often develops in the honey dew if it remain upon the leaves or twigs, and the spores of this fungus often cover it to such an extent as to make it look as though coated with soot. This gives a diseased appearance to the tree, and we are sometimes asked what should be done for such disease. Of course, it is not infecting the tree or plant, but is due to the presence of the honey dew upon which it drops, and of course, to the Aphids which produce the liquid. There is no need to give a remedy for the Black Smut, which may cover the leaves in patches like soot, but the remedy should be for plant lice which produce it.

Remedies.—As the Aphids multiply very rapidly and become numerous, their enemies likewise increase in numbers in their communities. In such places can be seen both the adults and larvæ of Lady Beetles, feeding freely upon them, as well as the larvæ of the Lace-wing (See Plate V, B), and the blind but very efficient larvæ of the Syrphus Flies. This last-named larva can be seen striking blindly in various directions for Plant Lice, and when it blindly strikes one, it holds it in the air, and by a pumping or sucking action, which can be seen plainly, sucks the juices from the body and throws it away, again striking blindly in every direction for a new victim. The Lady Beetles and their larvæ devour the Plant Lice, while the larva of the Lace-wing sticks its strong hollow jaws into them and through the cavities of these jaws suck their juices, and throws the bodies away; while the larva of the Syrphus Fly holds them in the air and pierces and sucks them as described.

Among other enemies of the Plant Lice are the birds, especially the Warblers, Wrens and Titmice in the spring time, Kinglets and

Warblers in the fall of the year, and the Chickadees during the winter time. This spring a gentleman from Mechanicsburg reported to us that a pair of yellow birds were feeding on something around his peach tree, and our inspection showed that these were the Summer Yellow Birds or Warblers, and that they were feeding abundantly upon the Peach Aphids, which had seriously injured and deformed the leaves of his peach trees. Last fall we saw the Kinglets and Warblers in the late fall feeding abundantly upon the fall brood of Apple Aphids, which had developed upon the leaves of the apple trees and were then laying their eggs. The Chickadee and Tufted Titmouse are known to be great enemies of the eggs of Aphids, which they are seeking as they swing around on the twigs, like little acrobats, during the winter time.

No insects multiply so rapidly as the Plant Lice, and none are more effectively held in check by their many enemies. Among the smaller insect enemies or internal parasites is the Braconid or a very small wasp-like insect, which feeds in the interior of the Aphid and bores its way out by making a hole in the back, over which it lifts a lid like a trap door. The dead and perforated Plant Louse is often seen.

Immense numbers of Aphids are destroyed by the fungous disease, which attacks them, and which causes them to swell like little balloons, turn brown and die, and remain for some time upon the leaves where they live. When Plant Lice commence to become abundant on the leaves, those that have been killed by this disease are generally conspicuous by their larger size and dark brown color. The leaves that are badly infested by this pest, and twisted out of shape or turning brown should be examined with care before attempting to spray them, and it may often occur, especially if the pests have been present for some days that they will be found dead or attacked by such a multitude of enemies which can be found among them, that it will be useless to spray for them, because the natural forces hold them in check. While there are no insects that multiply more rapidly than Plant Lice of different species, there are at the same time none which have a greater number of natural enemies which curve their outbreak.

The Corn Plant Louse (Aphis maidis) is one of the most common pests on corn roots in this State, and as it is attended and protected by Ants, we have the common inquiry as to what should be done for Ants on corn roots. As a matter of fact it is not the Ants that are the direct enemies of the corn, although they are responsible for the damage done by taking care of the Plant Lice, which are the real depredators. In the spring of the year, shortly after the corn appears above the ground, the Ants dig little tunnels at the roots of the corn plants, and then find the Plant Lice or their

eggs, and carry them to these burrows, and place them on the corn roots where they keep them and care for them, and in return obtain the sweet juice or honey dew secreted by the Aphis. The latter-named pest does considerable injury where it is abundant, and it has become so dependent upon the Ants that without them it would be unable to reach the corn roots and inflict this damage. There is no remedy after the plants are once attacked, but the proper method is to follow crop rotation, not planting corn the second year successively in a field where corn was previously attacked by the Corn Plant Louse; using fertilizer in the soil, which is for the purpose of invigorating the plants and helping them to overcome the effects of their attacks; plowing the ground in the late fall, and harrowing to break up the nests of the Ants, where the Aphis eggs are stored and cared for by the Ants during the winter time; keeping down the weeds by early spring cultivation, especially smart weed, pigeon weed, and grass on which these pests also feed; with a disk harrow, stirring in the late spring and also in the winter, when possible, the soil that is to be planted in corn the next spring.

There is a Gray Aphis found throughout the State of Pennsylvania on the leaves of Maple trees along streets in cities and villages. They especially attack the Norway Maple. During the months of May, June and July this Aphis multiplies in great numbers and causes the green leaves to fall abundantly. The fallen leaves, as well as those remaining on the trees, and the sidewalks themselves, are often covered with honey dew until they are shiny and look as though varnished. The presence of these pests often causes considerable alarm, and although they are very numerous during June and July, they disappear rather suddenly, as they seem to reach the end of their career on shade trees when the leaves become thick and tough and fully mature, about midsummer. We have observed many trees attacked by this pest, and although it can be killed by spraying with contact applications, such as are recommended elsewhere, we doubt if it is necessary to take the trouble of attempting practical remedies for it. The treatment we advise is to water infested trees, loosen the soil about their roots, use fertilizer or mulch to feed and invigorate them, and apply more water.

Most Plant Lice upon the foliage of plants are green, and consequently called "Green Aphids" or "Green Plant Lice." Among these are these species infesting the Apple, Rose, Cabbage and many other plants. The Green Aphids are delicate and easily destroyed by contact applications, made so dilute and mild that the plants which they infest will not be injured. The application, whenever they are present in such numbers as to justify it, will hold them in check. Sometimes this need not be oftener than once per month. It is not

necessary to spray for Plant Lice when they are not present, excepting when their eggs are on the twigs (such as those of the Apple Aphis, during the winter), when the winter remedies for scale insects will also kill them.

The Brown Aphids infest the Cherry, Peach and Plum, and are much more hardy or difficult to kill than are the Green species. It requires a more thorough application of the material, made a little stronger for these, than for the Green. As it is almost impossible to spray successfully for Plant Lice when the leaves are curled, because the liquid can not be forced to touch the pests, on account of the curling leaves which protect them, it is possible where trees and bushes are low enough to be reached by hand to make a solution of some contact insecticide, and by holding it in a pan and bending the twigs over, the infested leaves can be immersed and washed in the solution in such a way as to destroy the pests. Also, in many cases it is advisable to pick off and burn infested leaves or twigs, especially where they are few in numbers, or the pests are just starting.

To this Family belongs the dreaded Grape Phylloxera (Phylloxera vastatrix), which has destroyed the vineyards in this country to such an extent as to receive the name "Temperance Bug," especially in the fields of California. It makes itself manifest by the presence of small leaf galls, which are wrinkled, hairy and hollow, opening upon the upper surface of the leaf, and containing the Plant Louse. Also the roots of the vines become knotty or gall-like, and these knots contain the root form of the Phylloxera. It must be acknowledged that there is no easy method of attacking this pest of the grape, and the best preventive that is now known consists in planting resistant vines, which means the roots of the American variety or wild grapes, upon which the more choice or desired variety has been grafted.

Another peculiar Aphis is the one which produces the Cock's-comb Elm Gall, so called because the gall on the elm leaf formed by it looks like a cock's comb. Where the leaves are badly infested it is well to gather and burn them to prevent the spread of the pests, and burn all fallen and infested leaves.

Some Plant Lice are protected by a secretion of white waxy material that looks like wool, and they are consequently called the Wooly Aphis. (Plate XIII.) There is one species of Wooly Aphis often found upon the twigs of the Beech tree, and which may be seen swaying their bodies to and fro in unison. It is possible that this peculiar movement is an aid either in sucking the juices or driving away their minute parasitic enemies, or both.

The Wooly Aphis of the apple (Schizoneura lanigera) is one of the most commonly known pests of nurseries or orchards. It attacks the roots, trunks or branches, and even leaves of the Apple tree,

particularly where they are injured by bruising, and by feeding and reproducing in great numbers at such places they keep the wounds open or prevent healing and finally inflict a great deal of injury. They may form galls or knots, and in many cases cause the trees to remain dwarft and more or less sickly, without producing a proper crop of fruit. As they may live entirely under ground, upon the roots, and not be detected, there may be no intimation of their presence other than the lack of growth of the tree. Of course, similar symptoms may come from Crown Gall, which is a true plant disease and demands removal and burning. Watch for deep scars on the bark, with bluish white edges, which indicate the Wooly Aphis at work in such places, and paint them with a very strong solution of soap or with ordinary house paint or strong Kerosene Emulsion. Where the roots are infested, relief can often be given by uncovering them, and working Tobacco Dust well into the soil around them. In setting young trees watch for evidences of the presence of this pest, and wash injured or infested parts in strong solution of soap and water if they have not been fumigated. Some persons make a practice of putting a cake of hard soap in the forks of each tree that it can be dissolved and carried down by the rains and destroy certain insects on the trunks and roots. Spraying with the Lime-sulphur Wash destroys the Wooly Aphis as well as the eggs of the common Apple Aphis, and all other pests which remain exposed during the winter time upon the trunks, branches or twigs of trees so treated.

In greenhouses where such pests are abundant they are held in check by periodical fumigation with burning Tobacco. They can also be destroyed by spraying or dipping them into a decoction of Tobacco juices, made by steeping one pound of Tobacco in two gallons of water for an hour or two. Where they are present on house plants, they can be killed by setting them out of doors, and sprinkling them well with such a solution; or dip the plants into such a decoction. They can also be killed by holding them in the steam of a tea kettle for a brief time where it is just hot enough that one can bear to hold the hand over it, without scalding, during the same period of time.

FAMILY VIII. Aleyrodidæ. The White Flies.

The insects of this Family are exceedingly small, and the immature stages look like scale insects. They were for some time grouped with the Coccidæ, or the Family which is to be discussed next, and which forms the last of the Homoptera. However, in their mature state they are furnished with small but conspicuous white wings and fly readily. Although they are very small, they may become so numerous, especially in greenhouses, as to be quite destructive. They

are, of course, called "White Flies" from the color, but are so small as to be ignored or not observed by many persons. They occasionally, but rarely, attack plants, especially tomatoes, to a destructive extent outdoors; but in greenhouses, especially in the southeastern corner of this State, they have effected considerable damage to herbaceous plants of various kinds. Since they are also suctorial, they are not to be destroyed by internal poisons or arsenites, and can only be held in check by abundant spraying with contact insecticides, such as mentioned above, or by fumigation.

The most effective material for fumigating for these and other greenhouse pests is Hydrocyanic Acid Gas, generated by dropping Cyanide of Potassium into a solution of Sulfuric Acid and water, and leaving the room tightly closed for at least one-half hour. This gas is quite deadly, and should not be used by one who does not understand the method or has not previously read carefully what has been published here or elsewhere on this subject. As we have published in detail upon the methods of fumigation (See Vol. III, p. 110, Monthly Bulletin, Division of Zoology) with this important but deadly gas, and can send a printed description of the methods to each one applying for the same, we do not feel it advisable to take the space to re-publish upon this subject here.

(To be continued.)

THE GRAIN MOTH.

In many portions of the State of Pennslvania there is a small moth found abundantly, which in the larval stage, feeds in grains of wheat from the time the crop is ripe until fall. Especially where wheat is hauled into the mow and kept in the straw, unthreshed, it is liable to be attacked to such an extent that many of the grains are excavated and left very light and almost worthless. The insect doing this damage is the Angoumois Grain Moth, so called from the province of Angoumois, France, where it was first noticed doing extensive damage. It is now quite destructive throughout the southeastern quarter of this State, and as there is only one practical measure that can easily and safely be taken for it, we publish at this time to call the attention of farmers to the importance of threshing their wheat just as soon as possible after harvest and putting the grain into bins or store houses or selling it. If it is to be put into a bin to be kept for a long time, it can safely and easily be fumigated with Carbon Bisulfid, using one pound of this liquid for

each one hundred bushels of the grain. Pour the liquid over the top of the grain, in a tight bin, box or other vessel, and then cover it with wet blankets to keep the fumes from escaping. Keep fire away from it, as it is as explosive as gasolene.

However, it will not be necessary to go to the trouble and expense of fumigating if the grain is threshed early and put into storage. We have a record of one definite case where the farmer threshed half of the wheat crop in the field and the other half was hauled to the barn and kept in the mow until the early part of the winter before threshing. That which was threshed first was sold as first class wheat, because it was not injured by the larvæ feeding inside the grains, but the half that was kept in the sheaf and threshed later was almost entirely ruined by the pests.

The great point in this article is to advise wheat growers to thresh early, and either dispose of the crop or store it in tight bins. Do not permit wheat to remain in the straw, either in stacks or in the mow. If this advice be acted upon it will result in saving hundreds of thousands of dollars worth of wheat in this State. Infested grain is light in weight and little better than bran for either feeding or milling purposes. Thresh early and avoid loss.

THE ROSE BUG.

One insect that has appeared in great numbers throughout this State this year, and of which we have received many inquiries, is a small yellowish brown beetle commonly known as the Rose Bug or Cherry Bug. It is a serious pest in devouring leaves, flowers and fruit, eating irregular holes in the surface of the leaves, and even eating young grapes from the vines. It is so familiar to growers of grapes, cherries, roses and some other plants that it needs no description, and this article is for the purpose of giving a general answer to the many inquiries we have received concerning it.

There are but few practical remedies to be recommended. Arsenical poisons have not given satisfactory results when applied for this pest, for the reason that internal poisons are so slow in action that in many cases the pest is not killed until the damage is done, and also others appear on the infested trees from time to time as rapidly as those which have been poisoned die and disappear, and consequently it looks as though poisons have had but little effect indeed.

Contact applications are likewise unsatisfactory, because the beetle, having a hard shell, is not easily penetrated by oils or soap solutions, and consequently these are remedies that would give only partial relief and would not prove wholly satisfactory.

The most reliable remedy is to pick the pests from the plants they infest, and drop them into a vessel of water upon which a little Kerosene Oil is floating, or shake them into pans containing water and oil, or shake them over cloths held beneath the infested plants or spread upon the ground, and which have been soaked with Kerosene or covered with Tar. Blankets soaked with Kerosene, stretched or spread beneath infested trees or shrubs, give a most excellent means of fighting this pest, because the Rose Bugs will be killed by falling upon the saturated blanket, even though they should not be entirely covered by the oil. It is thus not necessary to go to the trouble of gathering every one by hand after they fall upon the saturated blanket. It would be sufficient to stretch sheets under the infested plants and shake the insects on them, rolling them together and dropping them into oil. Kill such pests while they are few in numbers to prevent their increase during another year. All shaking or jarring for such pests should be done either very early in the morning or late in the afternoon when the air is too cold for them to fly freely and they will drop when disturbed. The early part of the forenoon is best for this. If they do not fall by shaking they should be brushed off with sticks or picked by hand. At the present time nothing better for Rose Bugs is known than hand picking as here directed.

We have seen rose bushes effectively protected by covering with thin netting like mosquito netting during the period when these beetles are most destructive. Another plan is to plant as traps some kind of tree or bush the leaves of which are especially attaractive to the Rose Bug. Such an one is the sassafras. These insects feed mostly upon the sassafras leaves, and if a few small trees of this kind be planted in or near the lawn, garden or orchard the Rose Bugs will be attracted to them and it will not be a difficult matter to shake the pests from such trees once or twice per day and thus preserve others that cannot be so easily attended. It is to be noted that the leaves and twigs of the sassafras are particularly smooth, and it is much more difficult for the Rose Bugs to cling to them than to the leaves of such a plant as the Rose. It is hoped that this article will give answer to the many inquiries we have received this summer upon the subject.

FLEA BEETLES.

There are a great many kinds of small dark or brown jumping insects, with hard shells or coverings, inhabitating plants which grow low or near the ground, and which jump freely when approached

and leave their marks in the form of small brownish specks, eaten in the epidermis or covering of the leaves where they have been feeding. These insects are known as Flea Beetles from the fact that they jump like fleas, but they are true Beetles or "Case-winged Insects." They are not fleas by any means, and are not capable of attacking a human being or animal of any kind. Their chief injury is inflicted upon the leaves of plants by eating small holes partly through them until they may appear brown. Potatoes and beans are especially injured by insects of this kind, which subject was discussed on pages 353 and 354 of Vol. IV of this Bulletin. We there recommended driving these pests, with the wind, against boards or cloths covered with Tar, thus trapping them in great numbers, and also spraying with the Bordeaux Mixture and Paris Green added. The Bordeaux Mixture is a repellant, as the insects greatly dislike to feed upon any plants covered with it. The Paris Green aids by poisoning and also killing Potato Beetles and other insects that are present. Growers can not afford to let potatoes remain unsprayed when it is so easy and cheap to apply such material as Bordeaux Mixture and Paris Green, not only for these pests but also to prevent Blight and Rot and destroy other insects injuring the leaves.

The formula recommended for potato spraying is as follows:

Quick Lime, 6 pounds.
Copper Sulfate or Bluestone, 4 pounds.
Paris Green, one-third pound or 4 ounces.
Water, 50 gallons.

Spray liberally with this, and repeat it as often as is necessary if the material be washed away by hard rain, or at the longest once every ten days to two weeks. It will not only destroy such pests as Potato Beetles and Flea Beetles, but will also prevent Potato Blight and Rotting. Continue the application until after the vines are fully mature and ready to ripen.

On page 353 of Vol. IV of this Bulletin it was shown conclusively that our experiments with the Soda Bordeaux and Paris Green for the Flea Beetle were quite successful in giving good results, which were worthy of further trial by practical growers of such plants.

SPRAYING.

"Spraying" is a term too carelessly used and too generally applied by most persons. It merely refers to the process or method by

which a liquid material is thrown in very fine particles. This material may be either a fungicide, used to prevent the appearance of plant diseases, or an insecticide, used as a remedy for insects. The term "dust spray" is also coming into use, but this properly should be "dusting." Spraying can properly be defined as putting a liquid into the form of a spray or a very fine mist. For this purpose the operator uses a force pump to furnish the power, and a nozzle so constructed as to break the stream of liquid into a spray as it leaves the pump or hose. The liquid may contain materials to act as germicides, fungicides or insecticides. Among the last-named are the oils, soaps, caustic materials, decoctions, powders in suspension, and poisons, either in solution or held in suspension by the liquid. The method of spraying is practically always the same, and consists merely in covering with a thin uniform coating the tree, plant or other object to be sprayed. The time or date of spraying is of very great importance, and success or failure may be dependent upon the right or wrong time, and even though all other elements may be favorable. For plant diseases or fungi the spraying should be with some substance like Bordeaux Mixture, which destroys the fungus germs before they enter the plants, and should be applied before the plants show evidence of disease.

Nearly all applications for insects are made when the pests are actually present rather than before they come, and are more effective when applied when such pests are very young or when they are feeding most voraciously. Contact insecticides are designed to kill insects by merely touching them and not by being eaten by them. Among these are the oils and oil emulsions of various kinds, decoctions, such as tobacco juice; powders, such as hellebore, pyrethrum, buhac, etc., applied either dry or in liquids; soap solutions and caustic preparations such as the lime-sulfur wash. These are used for sucking insects, such as scale insects, plant lice, squash bugs and others that pierce and suck the plants but do not eat the tissue.

The internal poisons are used for chewing or biting insects, which eat the part of the plant where the material is to be applied. Only chewing insects can be killed by such poisons, which are generally some compounds of arsenic and are therefore called "arsenites." Among the chewing insects to be killed by internal poisons are grasshoppers, roaches, caterpillars, and beetles, or the so-called "hard-shelled bugs" of all kinds. In fact, if any insects eat away the surface of any part of the plant its attack is such that it can be killed by arsenical poisons, but otherwise such materials are not to be used for it.

Persons whose plants are infested should learn the nature of the pests and apply the proper remedies at the right time. The person who speaks of using the Bordeaux Mixture for any insects or Paris

Green for plant lice or scale pests indicates his entire lack of knowledge of the elements of combating plant pests, and can not hope to have success until he makes at least a slight study of this subject of growing importance.

COMMERCIAL SPRAYERS.

We are often asked the names and addresses of persons who will do commercial spraying, and have, therefore, made an effort to obtain these. The list given below is by no means complete, and has been obtained from various sources, which we regard as authentic, although we have not corresponded with the individuals given, and their names and addresses are here published without their knowledge, but with a view toward helping them as well as the community in which they live.

It may be that some person desires to have his potatoes sprayed for blight and rot, or his fruit sprayed for ripe rot, or plums or peaches sprayed for curculio, or apples, pears and quinces sprayed for the second brood of the codling moth, or the June spraying for the San José Scale or plant lice, or such other spraying as can and should be done during the summer months. Sometimes pests may appear almost suddenly, and the prime factor in their treatment is to apply remedies immediately. It is thus important to know where the owners of property that is being destroyed can obtain the help they need. For this reason we feel justified in publishing this list, and in inviting correspondents to give us other names and addresses of persons who are doing commercial spraying. Any one desiring to take up this business, which is recommended as one of the growing and needed enterprises of this State, will receive free assistance from this office.

Bedford County.

Mr. Todder, Bedford, Pa.
Mr. L. O. Walter, New Enterprise, Pa.

Berks County.

Mr. W. P. Ruth, Sinking Springs, Pa.
Mr. J. S. A. Schaeffer, North Heidelberg, Pa.
Mr. J. H. Giles, 123 S. Fifth Street, Reading, Pa.
Mr. W. K. Hummelreich, Blandon, Pa.

The Board of Poor Directors of Shillington have a Niagara outfit which they will rent.

Blair County.

Mr. N. A. Rhodes, Tyrone, Pa.

Bucks County.

Mr. H. L. Shelly, Quakertown, Pa.

Chester County.

Mr. Dennis Gallagher, Strafford, Pa.
Mr. J. D. Thomas, Whitford, Pa.

Clinton County.

Mr. H. S. Bollinger, Lock Haven, Pa.

Cumberland County.

Mr. John Hale, New Cumberland, Pa.

Dauphin County.

Mr. J. R. Snavely, Harrisburg, Pa.
Mr. E. B. Mitchell, Harrisburg, Pa.

Lancaster County.

Mr. Jacob Chambers, Lancaster, Pa., care Dr. S. T. Davis.
Mr. G. W. Bellman, Lancaster, Pa.
Mr. A. F. Trout, Quarryville, Pa.
Mr. C. D. Herr, Cresswell, Pa
Mr. G. B. O. Felty, Millersville, Pa.
Mr. B. F. Barr, Lancaster, Pa.
Mr. J. Wilmuth, 735 E. Orange Street, Lancaster, Pa.
Mr. Menno E. Shirk, Stevens, Pa.
Mr. Moses Lapp, Gap, Pa., R. F. D. No. 2.
Mr. Harlan Gatchell, Peters Creek, Pa., R. F. D.

Monroe County.

Mr. Randall Bisbing, E. Stroudsburg, Pa.

Montgomery County.

Mr. D. M. Ellis, Bridgeport, Pa.
Mr. H. E. Wohlert, Bala, Pa.
Mr. John M. Markley, Lansdale, Pa., Lock Box 245.

Mr. D. Simpson, 48 E. Oak Street, Norristown, Pa.
Mr. G. L. Oddy, Centre Square, Pa.
Mr. Wm. Sturzwecher, Lansdale, Pa.
Mr. Peter Reilly, Rosemont, Pa.

Northampton County.

Mr. J. N. Hartzell, E. Bangor, Pa., R. F. D. No. 43.

Philadelphia County.

Mr. Herbert Inman, 2419 N. College Avenue, Philadelphia, Pa.

Snyder County.

Mr. W. H. Bingaman, Beavertown, Pa.
Mr. J. J. Tobias, Beavertown, Pa.

Union County.

Mr. H. A. Taylor, Mifflinburg, Pa.
Mr. Geo. Kunkel, Lewisburg, Pa., R. F. D. No. 1.

York County.

Mr. John Gardner, E. King Street, York, Pa.

ROBINS DESTROY WIREWORMS.

Difference Between Observation and Interpretation.

It frequently happens that certain facts are observed definitely and consequently can not and should not be denied, but the interpretation is such that might lead to quite erroneous conclusions, and even evil results. One of the most important duties of the teacher of Nature Study or any branch of Natural History is to give training not only of the minute observation of facts, conditions and phenomena, but also their own interpretation and practical application.

An important case illustrating the difference between interpretation and observation is seen in that of a truck grower near Harrisburg, who recently observed Robins at work in his cabbage field, apparently pulling the cabbage plants in numbers, and he at once shot quite a number of the birds. When brought to trial by the Game Commissioner, he acknowledged having shot the birds because they were destroying his property in pulling the cabbage plants, and

testified that he had seen them take the plants in their bills, pull them up and throw them aside. He was not certain that they ate any part of the plant nor anything near the plant, and it might have been thought that they were doing it only for mischief. Doubting such an unusual occurrence as Robins pulling plants for the purpose of destroying them or without some definite and doubtless beneficial end in view, a representative of the office of the Economic Zoologist went with the Game Commissioner to the truck field where the cabbage was growing, and there they saw, indeed, Robins in considerable numbers hopping over the ground, and often stopping to pick up objects, and even scratching in the ground with their bills, and then eating something. They were particularly busy quite near the cabbage plants, and a number of plants were seen lying on the ground beside the hills, wilted and dying. A careful examination revealed the fact that the plants had been cut off rather than pulled out, and in at least one case the Robin was seen to throw aside one of these plants, which had been cut off but was yet standing in its hole in the ground. Around the foot of the plants and just beneath the surface of the soil worms were to be found by the hundreds. It was found that the wireworms had cut the cabbage plants, and the Robins were busily engaged destroying these very injurious pests for which there is practically no remedy, after they appear, and of which there are far too few enemies. The facts were that the truck grower observed the Robins at work around his cabbage plants, and perhaps occasionally lifting out some that had been cut off by wireworms, and he jumped to the conclusion that the Robins were pulling his plants, and proceeded to shoot his most beneficial friends. The correct interpretation was that the plants were cut off by pests for which there is no practical remedy at this time of year, and the Robins were feeding extensively on those pests, but as some of the plants remained in the ground where the wireworms were to be found, although cut off and dying, the birds found them in their way and threw them aside. It is doubtful if the killing of the birds was justified under such circumstances, even with the positive and conscientious belief that they were doing damage. It was the duty of the truck grower to ascertain the facts of the case and act intelligently upon them, fully as much as it was his duty or privilege to protect his crops.

Details of the above case are published for the sake of emphasizing the importance of correctly interpretating what is to be observed in Nature, and acting most intelligently and properly. It is generally wrong interpretation of observed facts which leads to the common popular errors concerning Natural History subjects rather than mere fabrication of false belief. For example, the popular erroneous idea that there is a Horn Snake with a poisonous sting in its tail

appears to be founded upon the observed fact that the House Snake or Milk Snake has a tail that is rather hard and pointed, and from the observation of this, the story of the Horn Snake appears to have grown. It is to be hoped that readers will join in aiding the work of the Economic Zoologist to ascertain and publish the truth in Nature.

SPRAYING POTATOES FOR BLIGHT AND ROT.

Dear Sir: In your Zoological bulletin I find the receipt for late blight on potatoes to be the Bordeaux Mixture. Can too much mixture be applied to the vines, if applied with an ordinary sprinkling can, or must it be applied only in a spray?

Thanking you for an early reply, I am,

Respectfully,

H. J. H.

Mr. H. J. Haldeman, R. F. D. No. 2, Jonestown, Pa.:

Dear Sir: Replying to your favor of the 15th making inquiry concerning the use of the Bordeaux Mixture, applied with a sprinkling can for late blight of Potatoes, I beg to say that I do not think that a man can possibly obtain good results by attempting to apply spray liquids with a sprinkling can. He might as well attempt to shave with a hoe, as to spray with an ordinary sprinkling can. There is just as much difference between shaving and hoeing as there is between spraying and sprinkling. The spray is for the purpose of throwing a liquid containing fungicide or insecticide into extremely fine particles, as fine as mist, in such a way that the leaves or fruit will be covered by a uniform film of this, as though with fine water dew, which should not run together, and should not stand in drops nor drop off the leaves. When applied in this way it will have no disastrous effects of burning the foliage, and will at the same time protect the plant tissues or destroy the insects.

If applied as a sprinkling can spray or with an apparatus that does not give a spray, the material falls on the plant in drops and may either collect in drops on the leaves and burn holes through them by being too greatly concentrated on those spots, or it will drop off entirely and in so doing it will leave streaks on the leaves or fruit where no fungicide will remain, and consequently the purpose of spraying will be defeated by leaving the leaves or fruit untreated

in such streaks. While some beneficial results may be obtained by sprinkling, the benefits of the spray are so much greater that it is important to insist upon spraying with apparatus that gives a fine spray or mist. Far better than sprinkling is to throw a fine liquid by dipping something like a whisk broom into a liquid, and snapping it against a stick or the hand of the operator in such a way as to flip the liquid in very fine drops, almost like a spray, so that it strikes the leaves in this way. By using a brush or fine broom it is possible in applying the liquid insecticide or fungicide to only a few plants, to obtain results that may be almost as good as spraying. Sprinkling will not give satisfactory results.

If we can aid you further at any time, please write to us.

Very truly yours,

H. A. SURFACE,

Economic Zoologist.

THE

ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

SUBJECTS: Nursery and Orchard Inspection.
Economic Entomology.

VOL. V, No. 4.

August 1, 1907.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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Volume V, No. 4.

Established in April, 1903, at the office of the Economic Zoologist,
Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

CONTENTS OF THE AUGUST ISSUE.

OUR MONTHLY CHAT WITH READERS.

Do you want a Bulletin on "The Turtles and Lizards of Pennsylvania" as a companion to "The Serpent Bulletin," issued a year ago? If so, please send us specimens at once. They may be sent by express, at our expense, or by mail (when postage will be refunded), either alive or dead, although we should prefer them sent dead.

* * * No Names Dropped From Mailing List.—We occasionally receive letters asking why names have been dropped from the mailing list, as the inquirer is not receiving the Bulletins. We take this occasion to state that no names have been dropped from our mailing list since the revision of the same a year ago last spring, and none will be dropped until the mailing list again increases enough to reach beyond the legal limit. However, this will not be for some time, as the last Legislature made provision for increasing the number of our Bulletins that are actually demanded by the public to the extent of fifty thousand if needed. We are not having that many printed at the present time, but if the demand should come for them, it is possible for us to obtain them.

* * * Change of Address.—In notifying us of change of address, you should always put the old address down as well as the new. This is necessary in order to make the proper change.

* * * Back Numbers Available.—Of some of the previous issues of the Monthly Bulletin the supply is exhausted, and of others there are yet enough available to complete sets for those who may wish to preserve the entire volume for binding. Those who need back numbers should write at once, definitely asking for the numbers which they need, and they will be sent if in stock.

Naming Collections of Insects: We take this occasion to make the preliminary announcement that beginning in November of this year, we shall be able to name free of charge such collections of Pennsylvanian insects as collectors may wish to make and submit to us for identification. This will aid teachers, pupils, amateur collectors and others in naming and classifying their material and will give them opportunity to commence now, during the summer time, to make collections with a view of having them named some time during this fall or winter.

In making collections care should always be taken to collect and preserve duplicate specimens and attach to each a collection number, giving the date, locality, food plant, and any other interesting notes of observations that may be recorded concerning each species. When the collection is sent to us this collection number should be sent with its respective specimen and a duplicate specimen should be retained by the collector with the same number attached to it, in order to facilitate identification or naming by reference to the number on the specimen.

Please address all specimens, notes and inquiries to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

NURSERY INSPECTION.

As the annual inspection of nurseries in Pennsylvania begins this month, it is appropriate to call the attention of the public to what the State is doing in this regard. Four men are at the present time devoting their efforts to inspecting the nurseries in the State of Pennsylvania. Wherever the San José Scale is found on nursery stock, or older trees on the nursery premises are infested, they are to be destroyed at once by the owner, who will be given a certain number of days in which to prepare for a second visit of the inspector. If no San José Scale be found on nursery stock or on trees on the nursery premises, a certificate, granting the right to sell from that nursery for one year, will be given at once without further requirements. However, if upon the second visit by the inspector, the San José Scale be yet found present in the nursery, the nurseryman will be given another time in which to rid the premises of pests by destroying all infested stock, trees, hedges, bushes, etc., and at the end of this second interval the inspector will make a third trip to the premises. The expense of this third visit and all necessary subsequent trips must be paid by the nurseryman, because of his failure to comply with the directions given during the first visit of the inspector and rid his premises of pests by destroying all infested trees and vines. The fumigating house must be ready to be tested by smoke by the inspector not later than his second visit.

Wherever San José Scale is found upon any premises if there be no fumigation house one must be erected immediately, and whether new or old, it must be thoroughly tested by the inspector, by smoke, to see if it be free from any leakage of gas whatever, and if any be found it must be made as tight as possible and will be tested again in order to determine its efficiency as a means of fumigation before a Certificate of Fumigation will be granted.

It is worth while indeed for the nurserymen to clean up their own premises and get their fumigating houses in proper condition to avoid the extra expense of otherwise additional and unnecessary visits of the inspectors.

Persons growing strawberry plants only are not to be regarded as nurserymen, and in the future their strawberry fields will not be inspected excepting in those cases where they wish to ship plants into other States and their shipping requirements demand that packages contain Certificates of Inspection. In such cases our State Inspector will visit the premises as soon as notified by the owners, and will make inspections and grant certificates when proper.

The following communication has been addressed to growers of strawberry plants:

The general practice of granting Certificates of Inspection to growers of strawberry plants who grow no other stock, will henceforth be discontinued.

In the future, inspections of strawberry plants will be made, and certificates issued only, in cases where this office has been notified of intended shipment to other States or countries, which, in order to be promptly accepted and forwarded, must be accompanied by a Certificate of Inspection according to the laws of the State for which it is destined.

Those who grow strawberry plants in connection with raspberry and blackberry plants, or other nursery stock, and who at present hold Certificate of Inspection will have their premises inspected as heretofore, without further notice.

Persons wishing to ship strawberry plants by freight or express, should notify this office and their premises will be promptly inspected at any time after August 1st of each year.

Please note that where strawberry plants are not to be shipped by railroad, they need not be accompanied with certificate of inspection, and growers are at liberty to sell such plants in Pennsylvania without any restrictions whatever.

H. A. SURFACE, Economic Zoologist.

E. B. ENGLE, Nursery Inspector.

It should be distinctly remembered that it is decidedly against the law to ship into this State any shrubs, trees, bushes or other plants without certificates of inspection being attached to the same, and all that are of varieties liable to attack by the San José Scale must also carry Certificate of Fumigation to show that they have been fumigated before being shipped. It is the duty of transportation companies to refuse to carry packages of nursery stock without copies of the proper certificates being attached to each, and to refuse to deliver such uncertified stock in this State. Dealers, or persons who are in the business of buying and selling trees, must not sell trees without a license from the Department of Agriculture, and to procure said license they must notify the Department, giving the full list of names and addresses of the firms which they wish to represent, whether they be in Pennsylvania or in other States. These nurseries will then be investigated, and if they be found to have certificates in their own respective States they will be permitted to send their stock into Pennsylvania without further requirement, (excepting the necessity of fumigation of all varieties liable to infesta-

tion by San José Scale), but if they be transacting business in such manner in their own State that they do not have certificates, their agents can not obtain licenses for operating in this Commonwealth.

To all tree dealers in this State the following circular letter has been addressed:

Dear sir: Enclosed find copy of Circular No. 4, containing blank for renewal of agents' and dealers' certificate. If you are now holding a certificate you will notice that it expires by limitation July 31, 1907 and that applications for renewal should be made before July 1, 1907. Kindly give this immediate attention and return application promptly, giving the names and addresses of all the nurseries from which you propose to procure your stock for the coming year.

If you are selling on salary or commission for one nursery only, said nursery holding a valid certificate of inspection, and also of fumigation for all stock liable to infestation by San José Scale shipped into Pennsylvania, you will not require a separate dealer's certificate, as the certificate of the nursery you represent will be sufficient.

Please read enclosed Circular No. 4 very carefully, and do not fail to give date, and signature of a witness, as provided for on blank application. Note especially, also, that a copy of Certificate of Inspection must be attached to each bale, box or package delivered, and if sent into Pennsylvania from any other State or Country, it must also have attached to each package the statement that it has been properly fumigated.

If representing one nursery only, on salary or commission, please report name of nursery to this office for record.

(Signed.)

N. B. CRITCHFIELD,
Secretary of Agriculture.
H. A. SURFACE,
Economic Zoologist.

To those tree dealers who have recently obtained new certificates the following circular letter has just been addressed:

Dear Sir: Enclosed find agents' and dealers' certificate for the year ending July 31, 1908. While the nursery or nurseries on your application, and from whom you propose to buy your stock for the coming year, are approved and have good and valid certificates of inspection, it is well to remind you that in this and many other states, all certificates expire, by limitation, at various dates from and after June 1, and that some nurseries which have certificates at this time may not have them renewed for the coming year.

Should we be advised later in the season that any nursery or nurseries named on your application have not succeeded in securing certificates, you will be duly notified from this office, and said nurseries will be stricken from the list and an opportunity given you to add the names of others instead.

Please remember that it is your privilege at any time, upon your notice to this office, to add to the list of nurseries from whom you expect to procure stock.

Special attention is called to the law requiring that nursery stock shipped into Pennsylvania from other states must not only be accompanied by a certificate of inspection, but must be fumigated before shipment. Copies of certificates of inspection and fumigation must be attached to each box, bale or package delivered, and every purchaser of a bill of trees, has a right to demand and be shown to his satisfaction that his trees have been inspected and fumigated, as required by law.

(Signed),

H. A. SURFACE,
Economic Zoologist.
E. B. ENGLE,
Nursery Inspector.

The following is a copy of our Circular No. 4:

To Agents and Dealers in Nursery Stock in the State of Pennsylvania:

In pursuance of authority vested in the Secretary of Agriculture by act of Assembly approved March 31, 1905, providing for the inspection of nurseries and infested premises, and the control of injurious insects and diseases; all tree agents and dealers doing nursery business within the State, except such as are properly accredited agents, canvassers, or salesmen for nurseries within or without the State holding valid certificates of inspection, will be required to file with this Department a statment or certificate, certifying that they will buy or receive for re-sale only such nursery stock as comes from sources approved by the Secretary of Agriculture or his duly authorized agents or representatives.

Agents or dealers who buy stock at wholesale, to be retailed from their own or any other premises, must do so under a dealers' certificate, which will be furnished free of charge by this Department under proper rules and restrictions.

As stated previously, agents or canvassers who represent properly certified nurseries, and that deliver stock only as packed by the firm they represent, can do so without certificate other than that held by the firm for which they are acting.

Applications for certificates must be made before July 1 of each year (or as soon thereafter as possible), so that proper time may be had for necessary investigations, and all applicants must state

where they expect or intend to get their stock. A copy of certificate must be attached to all packages delivered.

No stock can be legally sold in this State that is found to be infested with San José Scale, Black Knot, Yellows, Wooly Aphis or Crown Gall.

For certificates and further information address the Secretary of Agriculture or Economic Zoologist.

(Signed),

N. B. CRITCHFIELD, Secretary of Agriculture.

H. A. SURFACE, Economic Zoologist.

The tree dealer then fills the blanks in the following statement and files it in this office, when his certificate is sent to him.

Statement of Agent or Dealer.

To be Filed with the Secretary of Agriculture.

In consideration of the receipt of Certificate No. ...... for the year ending July 31, 19 , I hereby agree that I will purchase nursery stock for re-sale from the following firms only; such firms holding valid official certificates approved by the proper authorities.

LIST OF NURSERYMEN OR GROWERS.

....	....
....	....
....	....
....	....

(Permission is given to add to this list at any time by consent of the Secretary of Agriculture.)

I further agree that I will receive no nursery stock which is not accompanied by a Certificate of Inspection, and when shipped from without the State, which has not been fumigated; and further, that I will not sell or give away any stock whatever that has not been inspected.

......................................, Agent.

Witness, ...	P. O., ...
P. O., ...	County, ...
Date, ...	State, ...

The following persons have been granted new certificates as tree dealers in Pennsylvania for the year extending from July 31, 1907 to July 31, 1908, although, under the distinction made above, some may be agents rather than dealers:

ALLEGHENY COUNTY.

H. M. Devereaux, Swissvale, Pa.
W. B. Bockstose, Castle Shannon, Pa.
L. F. Miller, 1023 Garret St., Pittsburg, Pa.
E. C. Hauser, Bellevue, Pa.
Charles Honess, Allegheny, Pa.
J. F. Zimmerman, Emsworth, Pa.

BEAVER COUNTY.

J. C. Withrow, Vanport, Pa.
J. H. Gutermuth, Rochester, Pa.
A. E. Crouch, Rochester, Pa.

BERKS COUNTY.

Jacob H. Weand, Reading, Pa.
M. E. Smeltzer, Reading, Pa.
Alfred Dreibelbis, Reading, Pa.
L. M. Neischwender, Hamburg, Pa.

BLAIR COUNTY.

James Hopkins, Juniata, Pa.

BRADFORD COUNTY.

J. F. Gable, Athens, Pa.
Jos. E. Hamilton, R. D. No. 16, Rome, Pa.
J. P. Sibley, R. D. No. 16, Rome, Pa.

BUCKS COUNTY.

A. P. Kratz, Silver Dale, Pa.

BUTLER COUNTY.

Geo. W. Haine, R. D. No. 32. Callery, Pa.

CARBON COUNTY.

Paul Neihoff, Lehighton, Pa.
David N. Rehr, Lehighton, Pa.
L. B. Wagner, Weissport, Pa.

CHESTER COUNTY.

John Alcorn, Malvern, Pa.
F. W. Richardson, Paoli, Pa.

CLEARFIELD COUNTY.

Thos. W. Munro, DuBois, Pa.

CLINTON COUNTY.

W. W. Richie, Lock Haven, Pa.

CRAWFORD COUNTY.

J. C. Boyd, Guy's Mills, Pa.
F. M. Fleming, Cochranton, Pa.

CUMBERLAND COUNTY.

Ira E. Bigler, Camp Hill, Pa.
D. C. Rupp, Shiremanstown, Pa.
Towzer & Wolff, Carlisle, Pa.

DAUPHIN COUNTY.

Geo. F. Greenawalt, Hummelstown, Pa.
T. A. Woods, Harrisburg, Pa.
J. R. Snavely, Harrisburg, Pa.

DELAWARE COUNTY.

John Wetherill, Chester, Pa.

ERIE COUNTY.

W. S. Waldo, North East, Pa.
C. E. Powell, Lundy's Lane, Pa.
W. C. Batcheler, Erie, Pa.

LACKAWANNA COUNTY.

Giles L. Clark, Scranton, Pa.
A. J. Noble, Scranton, Pa.

LANCASTER COUNTY.

J. S. Holwager, Elizabethtown, Pa.

LEBANON COUNTY.

Samuel P. Moyer, Myerstown, Pa.

LEHIGH COUNTY.

N. C. Beachy, Allentown, Pa.

LUZERNE COUNTY.

H. M. Rogers, Dallas, Pa.

McKEAN COUNTY.

F. S. Palmer, Bradford, Pa.

MONROE COUNTY.

L. D. Eilenberger, E. Stroudsburg, Pa.

MONTGOMERY COUNTY.

A. E. Wohlert, Merion, Pa.

NORTHAMPTON COUNTY.

T. S. Headman, Seidersville, Pa.
Dominico Sebastino, Roseto, Pa.

NORTHUMBERLAND COUNTY.

H. F. Frank, Montandon, Pa.
Jos. Harris & Bro., Shamokin, Pa.

PHILADELPHIA COUNTY.

J. R. Giffen, 1826 No. Willington Street, Philadelphia, Pa.
Wm. Henry Maule, Philadelphia, Pa.
Walter P. Stokes, Philadelphia, Pa.
Henry F. Michel Co., Philadelphia, Pa.
Hosea Waterer, Philadelphia, Pa.
Johnson Seed Co., Philadelphia, Pa.

SCHUYLKILL COUNTY.

Walter J. Keller, Pottsville, Pa.
W. O. Snyder, Minersville, Pa.
D. H. Smith, Haas, Pa.

TIOGA COUNTY.

Arthur Edwards, Elkland, Pa.

UNION COUNTY.

J. G. Oberdorf, Mifflinburg, Pa.

YORK COUNTY.

C. H. Snyder, York, Pa.
J. H. Painter, York, Pa.

OHIO.

Jones & Vernon, Troy, Miama county, Ohio.

The following Tree Dealers held Certificates for the year ending July 31, 1907, but have not yet renewed their applications for the coming year:

ADAMS COUNTY.

R. E. Alden, Aspers, Pa.

BLAIR COUNTY.

Isaac N. Kemp, East Freedom, Pa.

CRAWFORD COUNTY.

A. B. Greenfield & Son, Conneautville, Pa.
G. G. Fish, Conneautville, Pa.

DAUPHIN COUNTY.

A. H. Shreiner, Harrisburg, Pa.
Gilbert Troutman, Millersburg, Pa.
J. M. Christman, Fort Hunter, Pa.

ERIE COUNTY.

E. E. Carr, North East, Pa.

LEHIGH COUNTY.

Thomas P. Roth, Orefield, Pa.

LUZERNE COUNTY.

W. H. Langyan, Hazleton, Pa.

MONTGOMERY COUNTY.

John Reig, Jenkintown, Pa.
L. H. Kline, Pennsburg, Pa.

NORTHUMBERLAND COUNTY.

C. H. Weaver, Watsontown, Pa.

SCHUYLKILL COUNTY.

Samuel Buehler, Schuylkill Haven, Pa.

WESTMORELAND COUNTY.

Joseph Thomas, Greensburg, Pa.

Such careful methods as those outlined above must result in greatly reducing the San José Scale that may be sent upon nursery stock, and no excuse exists for any dealer in trees, or nurseryman, to send infested stock to any customer in this Commonwealth. The purchaser has a right to demand to see both the Certificates of Inspection and Fumigation, and we can give the public assurance that we have planted many fumigated trees and find their growth to be as good and strong as those trees that are not fumigated. We do

not believe that fumigation, when trees are dormant, injures them in the least.

The man who is merely acting as a tree agent or representing only one firm, taking orders on either commission or salary, and not buying trees to sell in the capacity of a dealer, will be permitted to act or transact his business under the certificate of the firm which he represents, and thus is not required to obtain a special license from this Department.

The following is a full list of the nurserymen which are licensed to sell nursery stock in the State of Pennsylvania at the present time:

Adams County.

Name.	Place.	Acres
R. M. Elden,	Aspers,	3
C. A. Stoner,	Gettysburg,	3
Cornelius Bender,	Idaville,	1
E. W. Yengst, R. D. No. 1,	Idaville,	½
H. W. Sowers,	Latimore,	1½
Charles J. Wilson,	Mummasburg,	3
W. E. Grove,	York Springs,	10
H. R. Plank,	York Springs,	3

Allegheny County.

J. B. Murdoch & Co.,	Pittsburg,	2
Elliot Nursery Co.,	Springdale,	33
G. R. Elliot,	Westview,	1
Mark E. Head,	Bellevue,	½
John W. Jorden,	Millvale,	½

Beaver County.

Mackall Bros.,	Beaver,	20
*James Smith,	Beaver Falls,	6
A. P. Goodwin,	Industry,	12
*J. Hoyt,	Industry,	15
*Henry Finley,	Industry,	4
*A. J. Freed,	Homewood,	10
*W. A. Freed,	Homewood,	5
*Joseph and Charles Engle, R. D. No. 2,	Beaver,	12
*Arnold Bros., R. D. No. 2,	Beaver Falls,	9

Bedford County.

Austin Wright,	Alum Bank,	2

Berks County.

Wenrich Bros.,	Robesonia,	½

Butler County.

Pierce Bros.,	Butler,	10

*Grow berry or small fruit plants only.

Blair County.

Name.	Place.	Acres
F. A. Bowser,	Newry,	¼

Bucks County.

J. L. Lovett,	Emilie,	10
Somerton Nurseries, 125 S. 5th St., Phila., A. U. Bannard, Mgr.,	Somerton,	20
Henry Palmer,	Langhorne,	4
Horace Janney,	Newton,	5
D. Landerth Seed Co.,	Bristol,	5
The W. H. Moon Co.,	Morrisville,	200
S. C. Moon Co.,	Morrisville,	50
J. G. Youngken,	Richlandtown,	1
S. R. Trach, R. D. No. 1,	Springtown,	1

Chester County.

George Achelis,	West Chester,	200
The Conard & Jones Co.,	West Grove,	30
The Dingee & Conard Co.,	West Grove,	30
Rakestraw & Pyle,	Kennett Square,	200
J. A. Roberts,	Malvern,	16
Hoopes Bro. & Thomas,	West Chester,	600
J. B. Reif,	Spring City,	2
Benj. Connell,	West Grove,	4
E. B. Keating,	Kennett Square,	1½

Clearfield County.

W. S. Wright,	Clearfield,	½

Crawford County.

*Anderson Bailey, R. D. No. 66,	Cochranton,	12
*Henry Roberts, R. D. No. 66,	Cochranton,	4
*J. T. Reed, R. D. No. 66,	Cochranton,	2
*Park Bailey,	Cochranton,	3
*Samuel J. Cooper,	Cochranton,	4
*Lewis Swogger, R. D. No. 33,	Carlton,	2
C. L. Unger, R. D. No. 11,	Meadville,	3
Prudential Orchard Co.,	Shermansville,	25
*J. Q. Marsh,	Geneva,	2
*L. L. Wood,	Geneva,	2
*Peter Schaffner, R. D. No. 2,	Meadville,	1½
*James T. Irwin,	Cochranton,	1½
*Samuel Bailey, R. D. No. 66,	Cochranton,	1
Atkin & Hall, R. D. No. 41,	Linesville,	2½

*Grow berry or small fruit plants only.

Dauphin County.

Name.	Place.	Acres.
C. P. Scholl, R. D. No. 1,	Halifax,	6
Snavely & Trombine,	Progress,	3
J. M. Christman,	Fort Hunter,	½
Andrew Coble, R. D. No. 1,	Middletown,	2½

Delaware County.

P. Z. Supplee,	Collingdale,	25
J. J. Styer,	Concordville,	2
M. F. Hannum,	Concordville,	1
W. E. Caum (Lessee),	Haverford,	4
John G. Gardner,	Villa Nova,	5
Wayne Iron Works,	St. Davids,	5
H. H. Baltles,	Newtown Square,	
Joseph H. Brinton,	Camp Ground,	½

Erie County.

*A. F. Youngs,	North East,	4
*Orton Bros.,	North East,	5
L. G. Youngs,	North East,	20
*D. C. Bostwick & Son,	Ripley, N. Y.,	9
*M. E. Kelly,	North East,	4
*A. J. Youngs,	North East,	4
*W. E. Smith,	North East,	3
Emil Laurent,	Girard,	2

Fayette County.

J. Sterling & Son,	Masontown,	10

Franklin County.

J. W. Zook,	Chambersburg,	½
Geo. H. Wert (Forester),	Mt. Alto,	1
Henry Eicholz,	Waynesboro,	1
W. B. Reed,	Chambersburg,	¼

Fulton County.

Eli Covalt,	Covalt,	1

Juniata County.

*Elmer W. Graybill,	Richfield,	2
Jos. H. Landis,	McCullough's Mills,	3
*Augustus Frantz,	Richfield,	1
*S. H. Graybill,	Richfield,	5

Lackawanna County.

*George H. Colvin,	Dalton,	2
*Floyd H. Northup,	Glenburn,	2
John W. Shepherd,	Scranton,	4

*Grow berry or small fruit plants only.

Lancaster County.

Name.	Place.	Acres.
John G. Engle,	Marietta,	6
A. H. Erb,	Lititz,	½
Maurice Brinton,	Christiana,	20
W. P. Bolton,	R. F. D. McCalls Ferry,	2
D. D. Herr,	Lancaster,	5
H. H. Harnish,	Hubers,	2
Wilson Kready,	Mt. Joy,	1
Calvin Cooper,	Bird-in-hand,	2
O. W. Laushey,	Bird-in-hand,	2
A. W. Root & Bro., R. D. No. 1,	Manheim,	20
David S. Herr,	Mountville,	2
M. H. Musser,	Lancaster,	2
M. A. Kolp,	Elizabethtown,	1
B. F. Barr & Co.,	Lancaster,	3
Frank A. Suter,	Lancaster,	½

Lawrence County.

J. W. Hayes, R. D. No. 3,	Edinburg,	1
Butz Bros.,	New Castle,	1
A. S. Moore,	New Castle,	2
D. W. Fisher,	New Wilmington,	1
*Jas. R. Seley,	New Wilmington,	¼

Lehigh County.

W. B. K. Johnson,	Allentown,	30
Preston Kline,	Coopersburg,	1

Luzerne County.

I. A. Driggs,	White Haven,	
(Handles only native	ornamental shrubs.)	
M. A. Maffett,	Wilkes-Barre,	1

Lycoming County.

Evenden Bros.,	Williamsport,	2

Mercer County.

*George E. Brocklehurst, R. D. No. 20,	Jackson Centre,	2½
*J. E. Brocklehurst, R. D. No. 3,	Mercer,	1½
*J. W. & J. H. Allison, R. D. No. 10,	Mercer,	10
*J. T. McLane, R. D. No. 46,	Greenville,	4
*Hugh Hogue, R. D. No. 28,	Carlton,	2½
J. L. Hoobler & Sons, R. D. No. 34,	Hadley,	4
*W. A. Taylor, R. D. No. 34,	Hadley,	4
*W. R. Cribbs,	Mercer,	3
*H. W. Allison, R. D. No. 9,	Mercer,	2

*Grow berry or small fruit plants only.

Montgomery County.

Name.	Place.	Acres.
Chris Koehler,	Cheltenham,	2
R. B. Haines & Co.,	Cheltenham,	2
C. H. Wilson,	Gladwyne,	2
J. B. Heckler,	Lansdale,	4
J. W. Thomas & Sons,	King of Prussia,	70
J. Krewson & Sons,	Cheltenham,	15
T. N. Yates & Co.,	North Wales,	100
J. B. Moore,	Hatfield,	10
Adolph Mueller,	Hoyt,	40
T. Meehan & Sons, Inc.,	Dreshertown,	200
Wm. Sturtzbecker,	Lansdale,	½
Edward D. Droun,	Weldon,	¼

Northampton County.

Theodore Roth,	Nazareth,	2

Northumberland County.

Joseph Harris,	Shamokin,	¼

Perry County.

Geo. A. Wagner,	Alinda,	5

Philadelphia County.

W. W. Harper,	Chestnut Hill,	500
Thos. Meehan & Sons, Inc.,	Germantown,	75
T. N. Yates & Co.,	Germantown,	4
John B. Lewis,	Bustleton,	10
A. F. O'Connell,	Philadelphia,	10
John Stephenson's Son,	Oak Lane,	2

Somerset County.

Village Nurseries,	Harnedsville,	37
H. E. Daniels,	Harnedsville,	7

Susquehanna County.

*E. A. Smith,	Heart Lake,	4
*Geo. Sprout,	Montrose,	5
*B. D. Hinds,	Montrose,	2

Venango County.

Venango Nursery Co., R. D. No. 1,	Franklin,	6

*Grow berry or small fruit plants only.

PLATE XIV. Pear Fruit Clusters showing injuries by the Leaf Blister-Mite (*Eriophyes pyri* (Pgst) Nal.) Kindly loaned from Bulletin No. 283, New York Agricultural Experiment Station, Geneva, N. Y., by Dr. W. H. Jordan. Pennsylvania readers are requested to watch for evidences of this pest and send specimens from both Pear and Apple to the office of H. A. Surface, Economic Zoologist, Harrisburg, Pa.

PLATE XV. An Apple Leaf Cluster injured by the Leaf Blister-Mite (*E. pyri* (Pgst) Nal.) Kindly loaned from Bulletin No. 283, N. Y. Agr. Experiment Station, Geneva, N. Y., by Dr. W. H. Jordan.

Westmoreland County.

Name.	Place.	Acres.
John McAdams,	Mt. Pleasant,	2

Wyoming County.

Name.	Place.	Acres.
*Silas Decker,	Square Top,	5
*F. H. Fassett,	Meshoppen,	1

York County.

Name.	Place.	Acres.
Patterson Nursery Co.,	Stewartstown,	12
Geo. E. Stein,	East Prospect,	6
W. S. Newcomer,	Glenrock,	4
E. J. Weiser, R. D. No. 11,	York,	½

ORCHARD INSPECTION AND DEMONSTRATIONS.

At the present time there are competent inspectors assigned to certain districts of Pennsylvania, who are making inspections of premises for detecting the presence of most of the serious pests which are responsible for the annual destruction of at least twenty-five million dollars worth of property in this State. The chief pest for which they are inspecting is the dreaded San José Scale, which must be detected before the infested trees, bushes, shrubbery or hedges are destroyed by it, if we wish to preserve them. There is no great difficulty in killing the San José Scale, and in saving the infested plants if the work be done by the right material (boiled Lime-sulfur Solution), in the right way (by thoroughly spraying with two coats or applications), and at the right time (when the leaves are off the trees).

During the summer our chief purpose is to detect the scale and other serious pests and give instructions as to the presence of this and other pests and render such help as is possible toward suppressing them. This fall as soon as the leaves drop, we shall commence to give public demonstrations of the methods of spraying for the San José Scale and other scale insects. Other demonstrations, for other pests, will be given in the proper season and duly announced in newspapers and by posters.

*Grow berry or small fruit plants only.

Since the Stalk-Borer feeds entirely upon the interior of the plant, there is no way of reaching it by insecticides, and it is not possible to detect its presence until its effects become so conspicuous and serious as to prove almost destructive to the individual plant which it inhabits.

When plants are seen to be drooping, wilting or turning yellow, it is best to cut them off and examine them and see if they be infested with such pests as those here described. If so, all such infested vines or stalks should be burned as promptly as possible, in order to destroy the pest and prevent its increase and spread during another season.

During some years the Stalk-Borer attacks the vines of tomatoes, as well as potatoes, in great numbers, and does really considerable injury. For this reason it is of imperative importance that as soon as possible after the tomatoes are gathered or the potatoes lifted from the ground, all the stalks should be raked or harrowed together and burned by throwing them on a hot brush fire while they are yet green or as green as they can be gathered at the time. The point is, that they should be burned before they have become entirely dry enough to burn alone, as the pests will probably leave them before they reach that stage. The importance of pulling or cutting infested stalks and burning them as soon as the infestation shows can not be too greatly emphasized, as this is about the only means of combating this pest.

It should be remembered that this and other boring insects live in the stalks of weeds, and for this reason it is of the utmost necessity that all weeds large enough to sustain them should be cut and burned if the "worms" or larvæ have grown to anywhere near their maturity; or if the larvæ be yet small, it is sufficient to cut them and leave them lie on the ground, as the pests will not mature if they do not have stalks of plants in which to continue to bore and feed. For this reason it is most excellent practice to mow the weeds of Lambsquarter, Ragweed, Hog Ragweed, Bullweed, Artichoke, and in fact all other weeds large enough to sustain such borers—mowing them about the middle of the summer and again the latter part of August. If the weeds were not mowed during the latter part of July they should be mowed now at once, and if the larvæ be not mature it will not be necessary to burn them, but if they be fully an inch in length they are probably large enough to undergo their transformations and appear in increased numbers during the next summer.

We have found the following plants infested with the Stalk-Borer *(Papaipema nitela)*, and this list shows the wide possibility of its

range: Tomato, Ragweed, Sweet Corn, Oats, Blackberry (?), Giant Ragweed, Potato, Elder (?) Corn, Gooseberry, Lily and Borrage.

Summary.—Pull or cut infested plants as soon as they are seen to wilt or found infested, and mow the weeds everywhere on the premises, at least twice during the summer.

HOUSEHOULD FUMIGATION.

Mr. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I want to fumigate an old log house with Hydrocyanic Acid Gas or some other equally good gas, for bed bugs, ants, moths, etc. We are living in the house which is a one and one-half story, 28 feet by 20 feet, ground floor measurement.

The down stairs outer walls and the middle partitions have been covered with heavy building paper and over it wall paper. Up stairs the side walls—about four feet high—are daubed and plastered in the regulation fashion (as are also the walls down stairs, over which we have papered) and have been whitewashed.

The ceiling overhead and down the slope to the side wall is ceiled with close fitting boards. The gable ends are also ceiled with boards.

Please give me the necessary directions for doing the fumigating. I want, if possible, to rid the house of all the above mentioned pests, especially the bed bugs, which I believe come down from the roof.

Will it be necessary to remove furniture and clothing, and will the gas injure clothing in any way?

A prompt reply will be greatly appreciated.

Yours very truly,

X. X. X.

Harrisburg, Pa., July 16, 1907.

Dear Sir: Replying to your letter of the 15th, asking about the method of fumigating a house for household pests, I beg to say that this is a very important subject at this time of year. It is so easy to fumigate and kill all pests in houses that I am surprised that persons should suffer with insects, or even with rats and mice in their buildings, when the structures are tight enough to retain the poisonous gas for one-third hour or more. Of course, where the building is very loosely constructed, so that the air readily blows through it is almost impossible to fumigate with good results. However, there should be far more fumigation done in most of the houses of this State this summer than will be undertaken, and although it is an easy process and perfectly safe when done with sufficient care, it is indeed quite dangerous if not given full and careful attention.

A building as closely constructed as an ordinary dwelling house can be successfully fumigated, and all flies, bedbugs, ants, mice and rats in the rooms or in the walls can be killed. The material to use is a gas known as Hydrocyanic Acid Gas, which is made by putting Cyanide of Potassium or the deadly Prussic Acid into Sulfuric Acid and water. As soon as the Sulfuric Acid comes into contact with the Cyanide a deadly gas is given off, and to fill the lungs with it twice would cause instant death. As alarming as this statement may appear, it is possible to handle this material with perfect safety by following the directions here given. Ascertain the number of cubic feet in each room to be fumigated, and divide it by two hundred. This gives the number of ounces of Cyanide of Potassium to use as we recommend one ounce of Cyanide of Potassium for each two hundred cubic feet of space in each room. A little surplus of material will be better than an underdose. Compute the number of ounces of the Cyanide of Potassium needed for each and every room, and add these amounts together, and thus learn how much Cyanide will be needed, and then multiply this by two, and it will give you the number of ounces of Sulfuric Acid that will also be needed for the entire building. Order the Cyanide of Potassium and Sulfuric Acid of the local druggist or of a wholesale firm, such as Powers-Weightman-Rosengarten, Philadelphia, Pa. The Cyanide of Potassium should be 98 per cent. pure, and the Sulfuric Acid need be only the commercially pure, but should not be lighter than 1.83 specific gravity. Even though persons ordering the material do not know what this means, the druggist will know, and will furnish the material required to give proper results. Of course, directions should be given that they be not shipped in the same package for the reason that if the acid should break and come in contact with the Cyanide, it might cause serious results in any car or room.

After determining the cubic capacity of each room and ascertaining the number of ounces of Cyanide of Potassium that will be needed for fumigating each respectively in the proportion of one ounce for each two hundred cubic feet of space, the material should be carefully weighed or measured on scales sufficiently delicate to give accurate weights of an ounce or the fraction of an ounce. If one does not have such scales, he can take the material in small paper sacks to the store and there have it weighed. Put the Cyanide of Potassium into small paper sacks, putting into each sack the exact amount of material needed for each respective room, and mark on the outside of the sack the room for which it is intended, so that it can be placed in its respective room in the house upon returning.

Of the Sulfuric Acid two fluid or liquid ounces are to be used for each ounce by weight of the Cyanide of Potassium. This means

that on a druggist's graduate it should measure two ounces of Sulfuric Acid for each ounce of the Cyanide of Potassium needed for each respective room, and pour this into a bottle and label it for the room to which it is destined. Carry the Cyanide and the acid in separate receptacles to the house and to the rooms where they are needed. Spread several thicknesses of newspaper over the carpet in the middle of each room to be fumigated, and into earthen or stoneware vessels pour twice as many ounces of water for each respective room as the amount of the Sulfuric Acid for that room. This, of course, would be twice as many ounces of water by measure as Cyanide by weight. Do not use metal vessels for containing this liquid nor wooden vessels with metal hoops. The acid will be sure to destroy them and may give serious results in injuring the carpets. As leakages occur from the corrosive effects, pour the water into earthen, stone or granite vessels and pour the Sulfuric Acid into this. Put the small bag of Cyanide of Potassium on the floor beside the vessel containing the dilute acid. See that all the openings in the room are tightly closed, excepting the door through which the operator must pass out. Have the windows closed and the curtains drawn down, and if the windows do not fit tightly, stop them with cotton or damp strips of paper. Begin in the attic or upstairs rooms first. Get everything in readiness in all the rooms by having the acid poured into the water, and have the Cyanide in paper bags on the floor beside it. Pass from one room to another and drop the small paper bag of Cyanide into the vessel containing the dilute acid, and leave the room immediately and close the door tightly. Of course, if it be necessary to pass from one room to another in order to perform the fumigation of another room, the further room should be treated first and the bag should be dropped into the diluted acid in the second room on the way back. After treating the attic rooms, pass downstairs, and drop the Cyanide into the vessel in the upstairs rooms, and go on down and treat the rooms downstairs in the same way, being sure first that all doors and windows are closed, excepting those that will be needed for the passage of the operator. Of course, it will not be necessary to lock the doors if persons be warned or guarded against entering the house during the time of fumigation.

It will not be necessary to fumigate the basement or cellar, unless there be pests that are to be killed there, as the Hydrocyanic Acid Gas will not penetrate holes in the cellar walls and kill rats and mice that may be found there. For this particular purpose a liquid generating a heavier gas is used, and this liquid is Carbon Bisulfid, which is to be poured into the holes, and they should then be stopped with clay. The Carbon Bisulfid is explosive like benzine or gasoline, but the Cyanide of Potassium does not give off inflammable or explo-

sive fumes. Thus there is no real danger from fire in a stove during the time of fumigation.

Permit the house to remain closed for an hour or two and then open the outside doors, and let the air blow through, and by the use of a ladder or by having previously attached strings or ropes to nails, it is possible to open the windows from the outside and ventilate in this way. However, if for any reason one can not open the windows from the outside, he can by holding his breath and absolutely refraining from breathing, enter the room to be ventilated, throw up the windows and retire from it without inhaling. We have done this successfully on several occasions in our experimental work. It is even possible to occupy downstairs rooms while fumigating the rooms upstairs. This, of course, is to be done only by giving as full and free ventilation to the lower and occupied rooms as can possibly be made. However, we have seen this done successfully with no evil results whatever, yet it is probable that the best results are to be obtained from fumigating an entire house and leaving it closed for two hours.

It will not be necessary to remove from the house anything whatever excepting plants and pets that should be preserved. Growing plants left in rooms will be severely scorched, and any pets like birds or cats would be killed if left behind. The gas will not injure the most delicate fabrics or clothing, nor even food material. We have fumigated mills with this formula, and have cleaned them of the terrible pest known as the Mediterrenean Flour Moth, and afterwards made bread from fumigated flour, and have used it without any evidence of deterioration of quality due to fumigation. It is desirable that the gas should enter closets, bureau drawers and other articles of furniture that are usually kept closed, and for this reason that should be opened before the fumigation is made, and left open during that time.

The cost of fumigation is so slight that it is insignificant compared to the great amount of comfort it will bring when houses are infested with any of the ordinary insects of the household. By buying our Cyanide of Potassium in quantity, it costs us but twenty-seven cents (27c) per pound. Of course, to this the freight or express charges must be added, but if one should pay fifty cents (50c) per pound for Cyanide of Potassium at retail druggists, and five cents (5c) for the Sulfuric Acid, the cost of fumigation would not be sufficient to justify a person suffering from household pests of any kind. For example, in the particular case cited in the original inquiry, the house is said to be one and one-half stories, 28x20 feet. The exact height for area to be fumigated is not given, and consequently the cubic contents can not be ascertained with precision,

but presuming this to be 20 feet, the volume of the house, even by outside measurements would be 28x20x20, which is 11,200, divided by 200 in order to ascertain the number of ounces of Cyanide of potassium gives 56, or 3½ pounds. It is probable that the inside measurements would show that about 3 pounds of Cyanide of Potassium are needed for this fumigation, at 50 cents per pound, this would cost only $1.50, and twice as much Sulfuric Acid at 5 cents per-pound would cost only 30 cents, making the straight cost only $1.80 for the total fumigation, which should rid the house of pests and keep it clean until next spring, when a second fumigation will be justified.

The time required for doing the actual work is very slight, indeed, as any ordinary dwelling house can be prepared for fumigation, and all of the ingredients be procured and the actual fumigation commenced within an hour of time by the operator. Considering the ease, certainty, etc. with which the work is done we recommend it as a general means of relieving trouble with all household pests, such as flies, fleas, roaches, ants, bedbugs, clothes moth, carpet beetles and other insects, and only give the one warning as to the necessity of extreme care in avoiding breathing the gas after the Cyanide is dropped into the acid.

H. A. S. Economic Zoologist.

FUMIGATING SEEDS.

Dear Sir: I would like to save my own garden seed. I have a fine lot of dry peas, which I would like to save for seed next year. How can I treat them to keep the weevil out, or prevent the borers that perforate them?

Thanking you for past favors, I am,

Very truly yours,

R. N.

Mr. R. N., Falls Schuylkill, Philadelphia, Pa.:

Dear Sir: Replying to your recent letter, asking how you can keep such garden seeds as peas from the Weevil destroying them until you wish to plant them again in the spring, I beg to say that this can be done without great difficulty and without injuring the germinating quality of the seeds, by fumigating them with Carbon Bisulfid. The seeds should be placed in a vessel that can be tightly closed, and a flat dish like a plate or pie pan should be placed on them, and into this should be poured the liquid Carbon Bisulfid, after which the vessel should be closed tightly, and left closed for at least two or three hours. The amount of Bisulfid of Carbon to use, of course, depends upon the amount of seed to be treated. The

usual formula is one pound for ten bushels. However, there is not much danger of using too much, and for a few seeds it is well to put them into a wash boiler, and pour the Carbon Bisulfid into a dish over them, put on the lid and put a wet blanket over it to prevent the leakage of gas around the edges and let it remain for about three hours. Open it in the wind so as to prevent breathing the gas which has come from the liquid, which has formed by the evaporation of the liquid. Fire should be kept away from both the liquid and the fumes as these are explosive, but otherwise it is not especially dangerous.

Seeds and grains are not injured for germinating nor for food purposes by this treatment, but the pests which they contain are destroyed with certainty. In some cases it is possible that the insects in the egg stage will be present just at the time of fumigation, in which case the egg is not so susceptible to destruction by the fumes as the insects half grown, and for this reason it may be advisable to give a second fumigation a short time after the first, but for most insects, such as the Weevil, all that is necessary is to fumigate once to destroy thoroughly and properly all pests, and then place the seeds or grain in double paper sacks and tie them tightly and put them away and keep them for future use.

Hoping this gives you the full information you need, and offering you our further services when possible, I am,

Very truly yours,

H. A. SURFACE,
Economic Zoologist.

SPECIMENS RECEIVED DURING JUNE, 1907.

Number.	Specimens.	Date—June, 1907.	Name and Address.
	Insects.		
9273	(b) Oyster-shell Scale, ... (c) Canker Worm Eggs, ... (d) Tiger Beetle (C. 6-guttata), ...	1	Mrs J. U. Moore, Transfer.
9274	(a) Corn Bill-bug (Sphenophorus sculptilis.) (b) Fly larvæ, ...	3	D. Stout, Middletown.
9277	Corn Bill-bug (S. sculptilis), ...	3	W. W. Climenson, Honey Brook.
9278	Work of Leaf-eating Beetle (Prob. Paria sp.)	3	F. B. Yockey, Apollo.
9279	(a) Long-horn Beetle (Saperda obliqua). (b) Wood Borer (Prionus laticollis).	4	W. W. Climenson, Honey Brook.
9282	Insects, ...	4	J. F. and G. M. Landis, McCulloch's Mills.
9287	Terrapin Scale (E. nigrofasciatum),..	4	S. E. Swartz, Harrisburg.
9288	Work of Flour Moth (Pyralis farinalis).	4	L. A. Hill, Leechburg.
9289	Insect Galls (Rhodites bicolor), ...	4	E. Moran, Lock Haven.
9290	(a) Scurfy Scale, ...	4	H. C. Heilman, Montgomery.
9292	Scale Insect, ...	4	Mrs. W. T. Langdon, Eldred.
9295	(b) Biting Flies (Tabanidæ), ...	5	G. and J. Landis, McCulloch's Mills.
9297	(a) San José Scale, ... (b) Work of Leaf-eating Beetle on Raspberry Leaves.	5	J. I. Dauman, Honey Brook.
9298	Oyster-shell Scale, ...	5	Mrs. H. J. Cooper, Taylor.
9299	Cherry Aphids, ...	5	W. H. McElwee, Harrisburg.
9300	Coleoptera, ...	5	G. R. Pritchard, Harrisburg.
9306	Wolf Flies, ...	6	Geo. Von Neida, Womelsdorf.
9308	(a) Oyster-shell Scale, ...	6	N. J. Wells, Tunkhannock.
9311	Oyster-shell Scale, ...	7	D. P. Carrier, Corry.
9315	Bagworm Cocoon (T. ephemeraeformis).	7	H. H. Hawkins, Springforge.
9316	Scurfy Scale, ...	7	J. A. Hutchinson, Claysville.
9317	San José Scale, ...	7	C. L. Burgess, Lovelton.
9318	Work of Twig Pruner (Acrobasis rubrifasciella).	7	F. B. Brown, West Leesport.
9327	(c) Wooly Bear (Diacrisia virginica),	10	G. and J. Landis, McCulloch's Mills.
9329	Cecropia Moth, ...	10	J. R. L. Heichhold, Clearfield.
9330	(a) Cherry Aphids, ...	10	J. F. Dymond, Uniontown.
9331	(b) Rear Horse Beetle (Staphylinus maculosus). (c) Ground Beetle (Scarites subterraneous).	10	W. C. Dickson, Wayne.
9332	Currant Aphids, ...	10	L. E. Hobbs, Logan, Philadelphia.
9333	San José Scale, ...	10	Mrs. H. B. Harrison, Olney, Philadelphia.
9334	Rhubard Snout Beetle (Lixus concavus).	10	Miss C. B. Steele, Tioga.
9335	(a) Currant Aphids, ... (b) Cherry Aphids, ...	10	W. H. Shatto, West Fairview.
9337	Oyster-shell Scale, ...	10	D. H. Meck, New Bloomfield.
9338	Terrapin Scale (E. nigrofasciatum),..	10	Miss C. Lewis, Bryn Mawr.
9339	(c) Oyster-shell Scale, ...	10	Mrs. M. M. Hildebrant, Mt. Joy.
9342	Corn Bill-bug (S. sculptilis), ...	10	A. B. Grubb, Annville.
9343	Giant Water Bug (Benacus griseus),..	10	G. J. Wimmer, Nazareth.
9344	Stonefly Nymphs, ...	10	L. R. Donleay, Etters.
9354	Eyed Elater (Alaus oculatus), ...	11	W. H. Schuchers, Reynoldsville.
9357	Polyphemus Cocoon, ...	11	M. M. Gettel, Shippensburg.
9358	Sphinx Moth (P. carolina), ...	11	J. E. Creamer, Shippensburg.
9359	New York Plum Scale (E. prunastri),	11	G. M. Wilson, Muddy Creek Forks.
9360	Cherry Juice gathered by Bees, ...	11	Prof. F. G. Fox, Erwinna.
9361	Wireworms, ...	11	W. Kohr, Penbrook.
9364	Cabbage Root Maggot, ...	11	M. M. Fulton, Boiling Springs.
9367	Magnolia Scale, ...	11	F. A. Russel, Pittsburg.
9369	San José Scale, ...	11	J. A. Megargee, Coatesville.
9370	Wireworms, ...	11	Dr. Kalbfus, Harrisburg.
9379	(a) Leaf-eating Beetle (Paria 4-guttata.) (b) Strawberry Crown Borer (Otiorhynchus ovatus).	12	A. Deming, Lawrenceville.
9380	Euonymus Scale (Chionaspis euonymi),	12	J. D. Wentling, Greensburg.
9381	Carpet Beetle larva (A. scrophulariae),	12	A. B. Thompson, Mercer.
9382	Cherry Aphids, ...	12	D. R. Sechler, Danville.
9383	Giant Water Bug, ...	12	B. P. Strunk, Utahville.
9384	Saw-toothed Granary Weevil (Silvanus surinamensis).	12	M. R. Good, Narvon.
9386	Cherry Aphids, ...	12	A. W. Brumgard, Lock Haven.
9392	Lecanium, ...	13	J. G. Dillin, Brownsburg.
9393	May Beetle (Lachnosterna sp.), ...	13	J. W. Zaum, Norristown.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9394	(a) Cutworms, (b) Clover-leaf Beetle larvæ,	13	J. H. Rupp, Shiremanstown.
9396	(a) Cherry Aphids,	13	V. O. Switzer, Danville.
9397	Wireworms,	13	O. Springer, New Sheffield.
9398	(a) Oyster-shell Scale,	13	N. MacEwen, Kane.
9401	(b) Oyster-shell Scale,	14	E. M. Mixer, Union City.
9403	Scurfy Scale,	14	F. Field, Dunkard.
9407	Insects,	15	K. Geist, Covington, La.
9408	Wolf Fly,	15	E. C. McCullogh, Newville.
9410	Clear-wing Sphinx (Hemaris axillaris),	15	W. J. Young, Springville.
9420	(a) Noctuid larvae, (b) Moth larva,	17	A. Shoff, Colemanville.
9421	(a) Oyster-shell Scale,	17	W. J. D. Rose, Murrysville.
9425	Crane Flies,	17	R. Coover, Harrisburg.
9426	Corn Bill-bug (S. sculptilis),	17	W. W. Walton, Nine Points.
9427	Insects (4 species),	17	F. Anderson, Geneva.
9430	Oyster-shell Scale,	17	F. O. Hall, Conneautville.
9432	Ichneumon Wasp (Thalessa atrata),	17	S. Helsel, Queen.
9435	(b) Yellow Swallow-tail Butterfly (P. g. turnus). (c) Round-headed Apple-borer (Saperda candida).	17	S. Tooker, Easton.
9444	Pine Scale (Aspidiotus abietis),	18	Frank M. Day, Mt. Airy.
9445	(a) Fly gall (Cecidomyia pellex), (b) Apple-leaf Crumpler (Mineola indiginella.) (c) Basket Worm Cocoon (T. ephemeraeformis.)	18	J. W. Fryling, Sunbury.
9446	Corn Bill-bug (S. sculptilis),	18	M. R. Hinsdale, Sugargrove.
9447	Parasitic Wasp (T. lunator),	18	I. M. Tuthill, Upper Darby.
9448	Giant Water Bug (B. griseus),	18	T. E. Williams, Kittanning.
9449	(a) Terrapin Scale, (b) Oyster Shell Scale, (c) Putnam Scale, (d) Cherry Scale,	18	A. M. Gingling, Altoona.
9450	Oyster-shell Scale,	18	A. C. Schant, St. Mary's.
9451	Potato Flea Beetles,	18	W. H. Brandt, Chambersburg.
9452	Oyster-shell Scale,	18	R. H. Knowlton, Tiadaghton.
9453	(a) Currant Aphids, (b) Cherry Aphids,	18	O. Weaver, Millersburg.
9454	Sphinx Moth (Paonias excaecatus),	18	Mrs. T. D. McEldery, Transfer.
9456	Noctuid Pupa,	18	Dr. I. M. Weills, Harrisburg.
9460	(a) Oyster-shell Scale, (c) Aphids,	18	N. J. Wells, Tunkhannock.
9468	Scurfy Scale,	19	J. A. Breakey, Stanton.
9470	Lecanium on Rose,	19	J. A. Patterson, Stewartstown.
9472	Oyster-shell Scale,	19	S. C. Williams, Wynnewood.
9473	Insects,	19	U. E. Smith, Monroeton.
9474	(a) Yellow Swallow-tail Butterfly, (b) Io Moth,	19	Miss J. E. West, Danville.
9484	(b) Arctiid Moth (Estigmene congrua).	20	H. K. West, Danville.
9486	Bombardier Beetle (Calosoma scrutator.)	20	W. H. Kehl, East Greenville.
9487	Insects,	20	Miss E. P. Williams, Haverford.
9488	Lecanium,	20	J. Miller, Danville.
9490	(a) American Giant Water Bug (Belostoma americana.) (b) Calosoma scrutator,	20	G. R. Pritchard, Harrisburg.
9491	Chalcid Flies,	20	C. S. Anderson, Harrisburg.
9493	(c) Long-horn Beetle,	20	R. L. Jackson, McConnellsburg.
9494	Aphids,	20	J. E. Roberts, Danville.
9495	Cherry Aphids,	20	K. O. Thompson, Danville.
9497	(a) Oyster-shell Scale, (b) San José Scale,	20	E. B. Buckalew, Harrisburg.
9506	Benacus griseus,	21	G. S. Gerhardt, Harrisburg.
9507	Rose Chafers (Macrodactylus subspinosus).	21	M. B. Rowland, Jr., Fox Chase, Phila.
9508	Tortoise Shell Beetle (Coptocycla clavata).	21	E. B. Maule, Cochranville.
9509	Mole Cricket,	21	Miss E. E. Swartz, Newburg.
9510	Luna Moth,	21	Mrs. J. G. Gilbert, Waterford.
9511	Rose Chafers,	21	S. Hartley, Dunkard.
9512	(b) Work of Flea Beetles,	21	J. S. Hicks, Granville.
9514	8-spotted Forester (Alypia 8-maculata).	21	G. Houseal, Harrisburg.
9516	(a) Cherry Aphids, (b) Aphids on Quince,	21	W. M. Brosha, Antes Fort.
9517	Aphids,	21	G. R. Pritchard, Harrisburg.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9518	Bagworm Cocoons,	21	T. Oxford, Jr., Bangor.
9519	(a) Terrapin Scale, (b) Aphids,	21	D. Owen, Harrisburg.
9528	Eyed Elater,	22	C. Revie, Harrisburg.
9529	Giant Water Bugs,	22	C. F. Strickland, Kingston.
9530	Luna Moth,	22	Mrs. N. Colegrove, Gaines.
9531	Aphids,	22	C. H. Rich, Woolrich.
9532	Ichneumon Wasp (T. lunator),	22	E. R. Buzzell, Curwensville.
9542	Oyster-shell Scale,	24	J. Pyle, Barondale.
9543	Oyster-shell Scale,	24	A. Russel, Emporium.
9544	Flat-headed Borer (Dicerca divaricata.)	24	J. C. Franke, Coudersport.
9545	Lady Beetle larva,	24	E. W. Cooper, Oak Lane.
9546	(a) Stink Bugs, (b) Bag Worm,	24	J. G. Oberdorf, Mifflinburg.
9548	Grape-vine Tomato galls (Lasioptera vitis).	24	Dr. G. Haine, Linglestown.
9550	(a) Scurfy Scale, (b) Oyster-shell Scale,	24	J. M. Phillips, Pittsburg.
9551	(a) Aphids, (b) Lightning Beetles,	24	F. Cobb, Nicholson.
9552	Fly Gall,	24	P. S. Tooker, Easton.
9553	(a) Aphids, (b) Click Beetle,	24	W. Haun, Sharpsville.
9554	Wooly Aphids,	24	J. R. Snavely, Harrisburg.
9555	(d) Measuring Worm,	24	Mrs. B. Moore, Kane.
9556	Cecropia Moth,	24	Miss S. Pentz, Montoursville.
9557	Cecropia Moth,	24	E. R. Spatz, Mt.Carmel.
9558	Noctuid larvae,	24	T. Messner, Warren.
9559	Belostoma americanum,	24	E. Love, Meshoppen.
9562	Coptocycla clavata,	24	F. P. Jones, West Springfield.
9563	Alaus oculatus,	24	A. Barkley, Harrisburg.
9572	(e) Dragon Fly Nymph,	25	B. Gleoggler, Tobyhanna.
9577	Oak Gall (Andricus seminator),	25	A. E. Fisher, Duncannon.
9579	Aphids,	25	R. A. Forsythe, Media.
9582	(a) Scurfy Scale,	25	G. F. Hoy, Hublersburg.
9583	Long-horn Beetle (Xylotrechus colonus).	25	A. W. Young, Manheim.
9584	(a) Shot-hole Borers, (b) Rose Chafer, (c) Long-horn Beetle (Neoclytus erythrocephalus).	25	A. W. Sterrett, Oakville.
9585	(a) Oak Scale (Aspidiotus obscurus), (b) Rose Chafer,	25	W. W. Long, Washington.
9586	Cherry Aphids,	25	B. M. Stone, Stull.
9587	May Beetle (Lachnosterna spp.),	25	H. F. Shafer, Stroudsburg.
9590	Benacus griseus,	25	Dr. O. T. Everhart, Hanover.
9601	Cherry Aphids,	26	W. Chase, Conneautville.
9603	Eyed Elater,	26	M. W. Strealy, Chambersburg.
9604	Cynip Gall,	26	A. B. Moore, Reynoldsville.
9605	Solitary Bee (Agapostemon nigrocornis).	26	H. T. Borhek, Bethlehem.
9606	(b) Work of Potato Flea Beetle,	26	R. J. Belt, Wellsville.
9607	Apple Aphids,	26	W. G. Winner, Calvert.
9608	Maple Aphids,	26	H. J. Heckert, York.
9609	Pine Scale (A. abietis),	26	Miss H. Harris, Aldan.
9610	Wooly Apple Aphis,	26	Hon. Frank Wickersham, Harrisburg.
9613	(b) Work of Potato Flea Beetles,	26	C. F. Bingaman, Beavertown.
9614	(a) Oyster-shell Scale,	26	R. W. Peters, Laurys Station.
9615	Maple Aphis,	26	J. O. Gardner, York.
9616	Pupae shells of Sesia pyri,	26	H. T. Couch, Carnegie.
9618	Cherry Aphids,	26	W. G. Hammer, Germantown.
9620	Lepidoptera Larvæ,	26	L. M. Simon, Linglestown.
9622	Spittle Insects,	26	J. A. Patterson, Innwood, W. Va.
9623	Diptera Galls (Lasioptera vitis),	26	J. A. Hand, Moosic.
9624	(a) Cherry Aphids, (b) Scurfy Scale,	26	A. Hiller, Fairhaven.
9628	Insects,	27	J. F. Landis, McCulloch's Mills.
9631	(b) Aphid Galls,	27	P. S. Tooker, Easton.
9632	Webworm,	27	W. W. Ritter, Harrisburg.
9635	Work of Potato Flea Beetle,	27	B. L. Heming, Shillington.
9644	(a) Maple Aphids, (b) Lightning Beetles (Chauliognathus marginatus).	27	A. B. Parker, Norristown.
9646	May Flies,	26	R. Coover, Harrisburg.
9647	(a) Striped Cucumber Beetle (Diabrotica vittata).	27	S. M. Peters, Belleville.
9656	Maple Aphids,	28	C. H. Best, Bethlehem.
9657	Elm Coxcomb Gall (Colopha ulmicola),	28	H. S. Bollinger, Lock Haven.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9659	(a) Lady Beetle pupæ, ... (b) Cottony Maple Scale (Pulvinaria innumerabilis).	28	P. A. Bluhm, Nisbet.
9660	(a) Cherry Aphids, ... (b) Lady Beetle (Adalia bipunctata),	28	J. Hemminger, Carlisle.
9663	(b) Work of Potato Flea Beetles, ...	28	H. B. Haring, Camp Hill.
9664	Lightning Beetle (Podabrus rugulosus),	28	C. T. Bastian, West Wescosville.
9665	Shot-hole borers, ...	28	A. Schreiber, Dagus Mines.
9667	Insects, ...	28	J. F. Landis, McCulloch's Mills.
9678	(a) Rose Chafer, ... (b) Flea Beetle (Haltica chalybea), (c) Ground Beetle (Lebia virdis), ..	29	R. L. Jackson, McConnellsburg.
9680	(a) Rose Chafers, ... (b) Stalk Borer (Papaipema nitela),	29	J. F. Dymond, Uniontown.
9681	Cherry Leaf Slug, ...	29	J. O. Gardner, York.
9683	(a) Stag Beetle (Lucanus dama), .. (b) May Beetle, ... (c) Arctiid Cocoon, ...	29	Mrs. J. W. Atkinson, Buckingham.
9684	Sphinx Moth (S. drupiferarum), ...	29	H. Merring, Kizers.
	Invertebrates not Insects.		
9282	(a) Millipedes, ... (c) Crustaceans, ...	4	J. K. and G. M. Landis, McCulloch's Mills.
9290	(b) Mites, ...	4	H. C. Heilman, Montgomery.
9308	(b) Mites, ...	6	N. J. Wells, Tunkhannock.
9336	Maple-leaf Mite Galls, ...	10	J. W. Shepherd, Scranton.
9355	Millipedes, ...	11	G. A. Spring, Covington.
9398	(b) Mites, ...	13	N. McEwen, Kane.
9407	(f) Millipedes, ...	15	J. Geist, Covington, La.
9421	(b) Mites, ...	17	W. J. O. Rose, Murrysville.
9435	(a) Tick from Red Squirrel, ...	17	P. S. Tooker, Easton.
9450	(b) Mites, ...	18	A. C. Schaut, St. Marys.
9460	(b) Mites, ...	18	N. J. Wells, Tunkhannock.
9473	(f) Millipedes, ...	19	U. E. Smith, Monroeton.
9493	(b) Millipedes, ...	20	R. L. Jackson, McConnellsburg.
9549	Red Mites, ...	24	T. E. Williams, Kittanning.
9572	(d) Crayfish, ...	25	B. Gleoggler, Tobyhanna.
9582	(b) Mites, ...	25	G. F. Hoy, Hublersburg.
9614	(b) Millipedes, ...	26	R. W. Peters, Laury's Station.
9627	(c) Spider Egg Mass, ...	27	J. Couch, Canonsburg.
9647	(b) Mites, ...	27	S. M. Peters, Belleville.
9661	Leech, ...	28	A. Cunkle, Harrisburg.
	Reptiles, Batrachians and Fishes.		
9628	Granite Salamander (Plethodon glutinosus).	1	W. R. McGinnis, Parker's Landing.
9269	(a) 2 Hellbenders (Cryptobranchus alleganiensis). (b) Queen Snake (Regina leberis),.. (c) Blacksnake (Bascanian constrictor).	1	R. W. Wehrle, Indiana.
9275	Rattlesnake (Crotalus horridus), ...	3	F. G. Couch, Andersonburg.
9280	Ring-necked Snake (Diadophis punctatus).	4	F. Mayer, Johnstown.
9285	(a) Common Water Snake (Natrix sipedon). (b) Rock Snake (Storeria dekayi),.. (c) 2 Granite Salamanders, ... (d) 2 Newts (Diemictylus viridscens) (e) Red Salamander (Spelerpes ruber).	4	F. D. Keboch, Williamstown.
9293	3 Hellbenders, ...	5	R. W. Wehrle, Indiana.
9294	Common Garter Snake (Thamnophis sirtalis).	5	S. J. Fritch, Berwick.
9295	(a) Common Water Snake, ...	5	G. and J. Landis, McCulloch's Mills.
9296	Grass Snake (Liopeltis vernalis), ...	5	W. H. Schuckers, Reynoldsville.
9302	House Snake (Lampropeltis doliatus triangulus).	6	A. W. Smith, Blairsville.
9310	House Snake, ...	7	C. A. Benner, Farrandsville.
9313	(a) Common Garter Snake, ... (b) Common Water Snake, ...	7	G. and J. Landis, McCulloch's Mills.
9322	Common Lizard (Sceloporus undulatus).	8	H. A. Brightbill, Marsh Run.
9323	(a) 6 Common Water Snakes, ... (b) 1 House Snake, ...	8	G. and J. Landis, McCulloch's Mills.
9324	2 Hellbenders, ...	8	J. H. Hawkins, Harrisburg.
[illegible]	Southern Lizard (Sphaerodactylus notatus Baird).	10	W. W. Climenson, Honey Brook

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9327	(a) Blacksnake, ... (b) Common Water Snake, ...	10	G. and J. Landis, McCulloch's Mills.
9328	Spreckled Turtle (Clemmys guttatus),	10	G. R. Pritchard, Harrisburg.
9341	(a) Black Snake, ... (b) Newt, ... (c) Land Salamander (Plethodon cinereus).	10	I. H. Leibelsperger, Fleetwood.
9346	Common Water Snake, ...	11	W. O. G. West, Danville.
9347	Painted Turtle (Chrysemys picta), ...	11	C. L. Gruber, Kutztown.
9348	Common Water Snake, ...	11	A. Robertson, Sharon Hill.
9350	Blacksnake, ...	11	C. T. Cornman, Carlisle.
9351	Common Water Snake, ...	11	A. W. Smith, Blairsville.
9352	(a) Box Tortoise (Terrapene carolina). (b) Common Garter Snake, ...	11	R. W. Wehrle, Indiana.
9353	House Snake, ...	11	W. B. Summers, James Creek.
9372	Pilot Snake (Callopeltis obsoletus), ..	12	L. McDonough, West Brownsville.
9373	3 Hellbenders, ...	12	R. W. Wehrle, Indiana.
9374	2 Common Garter Snakes, ...	12	T. A. Berkey, Easton.
9375	Common Garter Snakes, ...	12	A. W. Smith, Blairsville.
9389	House Snake, ...	13	C. E. Cole, Siegfried.
9390	Pilot Snake, ...	13	R. W. Wehrle, Indiana.
9401	(a) Granite Salamander, ...	14	E. M. Mixer, Union City.
9404	Blacksnake, ...	14	A. C. Rutter, Perkasie.
9407	(a) Turtle (Kinosternon pennsylvanicum). (b) Striped Lizard (Eumences fasciatus). (c) Common Water Snake, ... (d) Queen Snake, ...	15	K. Geist, Covington, La.
9413	Pilot Snake, ...	17	E. F. Benfer, Winfield.
9414	Hellbender, ...	17	R. W. Wehrle, Indiana.
9418	3 Land Salamanders, ...	17	L. R. Donleay, Etters.
9419	House Snake, ...	17	E. D. Gardner, Easton.
9423	House Snake, ...	17	U. L. Moyer, Bally.
9424	House Snake, ...	17	W. H. Kretchman, Me.
9437	Queen Snake, ...	18	R. W. Wehrle, Indiana.
9438	(a) Common Water Snake, ... (b) Ring-necked Snake, ...	18	A. W. Smith, Blairsville.
9440	House Snake, ...	18	C. H. Richter, Bittinger.
9441	House Snake, ...	18	A. W. Smith, Blairsville.
9442	2 Pilot Snakes, ...	18	W. O. Sleep, Bushkill.
9458	Common Garter Snake, ...	18	E. A. Berkey, Easton.
9461	Newts, ...	19	L. I. Seamon, Cresson.
9464	(a) Box Tortoise, ... (b) Snapping Turtle (Chelydra serpentina).	19	D. M. Lehman, Essington.
9465	Pilot Snake, ...	19	Col. W. D. Dixon, St. Thomas.
9467	(a) House Snake, ... (b) Blowing Viper (Heterodon platirhinos). (c) Common Water Snake, ... (d) Ring-necked Snake, ... (e) 2 Varied Tree Frogs (Hyla vercicolor). (f) 2 Sculptured Turtles (Clemmys insculptus).	19	F. D. Keboch, Williamstown.
9476	Pilot Snake, ...	20	C. A. Palmer, Warfordsburg.
9477	Pilot Snake, ...	20	W. E. Benner, Vicksburg.
9478	Queen Snake, ...	20	R. W. Wehrle, Indiana.
9479	House Snake, ...	20	C. Auch, Williamsport.
9480	2 Pilot Snakes, ...	20	C. A. Benner, Farrandsville.
9482	Common Garter Snakes, ...	20	Dr. G. Free, Danville.
9483	(a) Pilot Snake, ... (b) Common Garter Snake, ...	20	A. W. Smith, Blairsville.
9493	(a) 2 Green Frogs (Rana clamitans),..	20	R. L. Jackson, McConnellsburg.
9496	2 Common Garter Snakes, ...	20	Fred. Ruof, Hummelstown.
9503	Rattlesnake, ...	21	Dr. H. G. Nickel, Johnstown.
9504	Common Garter Snake, ...	21	S. Anderson, Harrisburg.
9505	House Snake, ...	21	F. Ruof, Hummelstown.
9522	Pilot Snake, ...	22	J. Berrier, Andersonburg.
9523	Red Salamander, ...		
9524	Common Garter Snake, ...	22	J. Bohn, Onset.
9533	Coral Snake (Osceola elapsoidea), ...		K. Geist, Covington, La.
9535	(a) Rattlesnake, ... (b) Pilot Snake, ...	24	C. A. Benner, Farrandsville.
9536	2 Copperhead Snakes, ...	24	J. H. Wilson, Huntingdon.
9538	House Snake, ...	24	B. Long, Ashbourne.
9547	Grass Snake, ...	24	W. L. Mann, West Fairview.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9569	Pilot Snake,	25	R. W. Wehrle, Indiana.
9570	(a) 2 Queen Snakes, (b) Pilot Snake, (c) Common Water Snake,	25	G. W. Gordon, Brownsville.
9572	(a) Common Water Snake, (b) 3 Newts, (c) Jeffersonian Salamander (Amblystoma jeffersonianum).	25	B. Gleoggler, Tobyhanna.
9573	Common Water Snake,	25	R. Toner, Farrandsville.
9574	Rattlesnake,	25	R. W. Wehrle, Indiana.
9576	(a) Queen Snake, (b) House Snake, (c) Common Garter Snake, (d) 4 Granite Salamanders,	25	W. H. Kretchman, Meyersdale.
9578	House Snake,		A. W. Smith, Blairsville.
9595	Blacksnake,	26	W. C. Dickson, Wayne.
9596	Common Garter Snake,	26	Miss C. B. Steele, Tioga.
9598	Pilot Snake,	26	S. Johnston.
9599	Common Water Snake,		C. H. Richter, Bittinger.
9600	(a) 2 Sculptured Turtles, (b) 1 Snapping Turtle,	26	R. W. Wehrle, Indiana.
9619	House Snake,	26	T. A. Berkey, Easton.
9626	(a) Common Water Snake, (b) Spreckled Turtle,	27	L. R. Donleay, Etters.
9627	(a) Snapping Turtle, (b) Brown Salamander (Desmognathus fusca).	27	J. Couch, Canonsburg.
9628	(a) House Snake,	27	F. Landis, McCulloch's Mills.
9629	Copperhead Snake,	27	R. W. Wehrle, Indiana.
9631	(a) Box Tortoise,		P. S. Tooker, Easton.
9650	Pilot Snake,	29	L. S. Peiffer, Fredericksburg.
9652	House Snake,	28	J. F. Landis, McCulloch's Mills.
9667	Blowing Viper,	28	J. E. Landis, McCulloch's Mills.
9669	(a) Snapping Turtle, (b) Painted Turtle, (c) Green Frog, (d) Hoptoad (Bufo lentiginosus americanus).	28	R. L. Jackson, McConnellsburg.
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9672	Rattlesnake,	29	A. Tyler, Farrandsville.
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9267	Wood Thrush,	1	M. D. Braliier, Conemaugh.
9276	Scarlet Tanger,	3	C. A. Beach, East Stroudsburg.
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9312	Jumping Mouse (Zapus hudsonius),	7	W. J. Young, Springville.
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THE ZOOLOGICAL BULLETIN

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DIVISION OF ZOOLOGY

OF THE

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SUBJECT: Insect Collection.

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H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

CONTENTS OF THE SEPTEMBER ISSUE.

OUR MONTHLY CHAT WITH READERS.

Our reasons for publishing this month on the methods of making collections of insects are that this is the month of the opening of schools, and teachers may be desirous of interesting their pupils in making collections, either for school purposes or for private use.

Entomology as an avocation or mere fad is one of the most interesting and refreshing subjects, and every person is justified in having both a vocation, or pursuit, and an avocation, or means of recreation. Also, many persons are attempting to make collections of insects, but without systematic or reliable directions, and their results are not satisfactory. The many farmers' clubs, granges and alliances now meeting regularly in their halls in this State can well make collections of their insect foes and friends, and have them named by sending them to this office or by other means, and put them on exhibition that they may be studied and used as a basis of practical work in destroying those that are obnoxious and preserving those that are beneficial.

It must be acknowledged that Nature Study in the public schools has not moved forward in Pennsylvania as in any of her neighboring States. This is mostly for the reason that our naturalists and educators have not taken the active steps in promoting the study of nature in the elementary schools or in the public schools. If the advanced students in nature themselves take no interest in the subject for beginners, they can not expect other persons to do so. There is no doubt of the great ethical value of every branch of Nature Study, and we hope to give such assistance as is possible to teachers and parents who are willing to try to develop this subject.

Our justification in publishing again upon the subject of making collections of insects is found in the scores of letters which we have received from students and teachers in various parts of this State, asking if it be possible to republish in a single volume the directions for collecting and preserving insects, which were formerly issued from this office as parts of such discussion published in various issues of our Monthly Bulletins. We solicit correspondence, specimens and exchanges.

Address all communications to H. A. SURFACE, Economic Zoologist, Harrisburg, Pa.

HOW TO MAKE A COLLECTION OF INSECTS.

BY H. A. SURFACE, *Economic Zoologist of Pennsylvania.*

As this is the month of the opening of schools, and also the best time in the entire year for the study of certain specimens, it is appropriate for us to take this means of answering questions on how to make a collection of insects.

Collecting Insects vs. Birds.

In the first place, there are not the objections to collecting insects that can and should be made to collecting birds. Some of the reasons for this statement are as follows:

(1) Insects in their adult or winged form are very short lived, existing but long enough in this stage to perform the purposes of nature in reproducing their kind. When they are collected and preserved they have reached the limit of their period of natural existence upon the earth, and would soon die by natural consequences, if not preserved by the entomologist.

(2) Insects are much more numerous than birds and the extermination of a few or even of many specimens would not result in the perceptible reduction of creatures valuable to man, even though they should be beneficial insects.

(3) Insects multiply so rapidly that any reduction in their numbers would soon be regained and the loss of even a great many would not be noticeable in any one region. Whereas, birds multiply slowly, and the extermination of those found in any one region would mean the absence of birds from that locality for some length of time.

(4) The common insects are more likely to be injurious than beneficial, and all of the leaf-eating species may properly be called injurious insects. In destroying them one is conferring a favor upon mankind by saving his property, whereas birds are much more likely to be beneficial than injurious, and in destroying them the property of mankind would suffer loss through the increased destruction wrought by insects upon which birds would feed.

(5) Insects are so low in their organization that they do not suffer much, if any, pain when captured, and do not suffer from freight as do birds, which are among the most highly organized and sensitive creatures upon the earth.

(6) In killing insects there are no agonies of the death throe to be seen by the collector and to destroy the keener sympathetic features of his nature by making him coarse and brutal, as in killing birds.

(7) Insects are easily handled, the work with them is clean, and the training in deftness or skill for the fingers in properly pinning and spreading them is of great value.

(8) Insects are so varied in structures, habits, haunts, etc., and so numerous that they can be collected in sufficient numbers to illustrate nearly all of the important laws of nature in relation to biology or living things. A collection once made is never completed, but becomes a nucleous for the addition of further material. No collector in any country pretends to have nearly all the insects found in his own locality, although his collection may number tens of thousands. Not only are species new to the collector constantly occurring, but also many that are entirely new to science. These new forms may be found in any portion of our country by careful effort. The full life histories and natural enemies of very few, even of our common insects are known to mankind, and every time the entomological collector goes into the gardens, fields, orchards, woods, or along ponds or streams, he can see and learn something new. Nature thus becomes to him an open book with new pages turned every day.

Apparatus:

The person who wishes to make a collection should provide himself with certain necessary material. He should have small tin boxes in which to carry the leaves or other parts of plants containing feeding larvae, or immature insects. He should also carry a

Fig. 1.—Cyanide Bottle. Used for killing insects when collected. Original. Drawn by W. R. Walton in Office of Economic Zoologist.

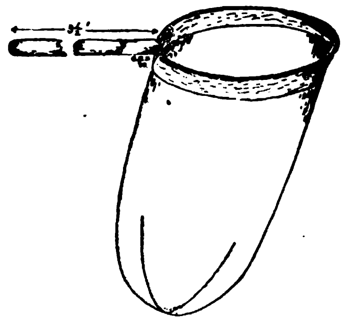


Fig. 2.—Net for collecting specimens in the Air. From Bulletin by Prof. E. P. Felt, State Entomologist of New York.

cyanide bottle for killing specimens he does not care to keep alive. He should also have several bottles of formalin or dilute alcohol, with labels on each. The cyanide bottle (shown in Fig. 1), is easily made by dropping a lump of cyanide of potassium the size of a small hickory nut into a large-mouthed bottle or jar, and covering it with plaster of Paris, then pouring on enough water to make it set, and standing it upside-down to drain and harden. After it is dry cover

the plaster with a sheet of blotting paper, cut just large enough to fit snugly the inside of the bottle, and crowd it in like a gun wad in the barrel of a gun. Keep this bottle corked tightly at all times except when it is necessary to open it, and as much as possible avoid breathing the fumes. All kinds of insects can be killed within a few minutes by dropping them into it. An excellent killing bottle can also be made by pouring a few drops of chloroform upon a small wad of cotton in an empty jar or bottle. For a person doing much field work, a killing jar, such as a pint fruit jar, will be found very useful.

The collector will also need a net, shown in Fig. 2, which may be made of a wire hoop a foot or more in diameter inserted into a handle like a cane, and covered with a bag of mosquito netting or cheese cloth about two feet deep. The patterns for this net are shown in Fig. 3. Either form makes a good bottom.

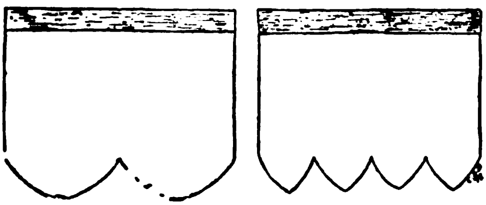


Fig 3.—Net Patterns. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

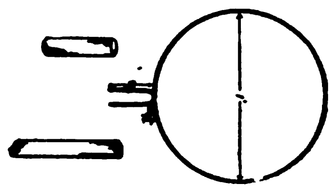


Fig. 4.—Plan of net frame and handle. From Bulletin of N. Y. State Museum by Prof. E. P. Felt.

Mosquito netting is too delicate for much use in collecting and the meshes are too large to hold very small specimens. The best material we have found is old silk bolting cloth from flour mills. Around most flour mills thére may be found pieces of bolting cloth which have been rejected because very small holes in them have made them unfit for service. Such material is strong enough not only for nets for collecting in air but also for water nets.

A very serviceable plan of water net is our original design shown in Fig. 5, which consists of a small conical net with a small hoop around the bottom which should otherwise be left open and suspended in the larger net which is to hold the aquatic creatures. Both are attached to the same rim and the small net acts in the same capacity as the mouth of a fish basket. The collector will find this especially useful in capturing rapidly moving aquatic creatures.

He will also find an umbrella useful, not only to keep off the sun and rain, but also to open and hold upside-down under the branches of trees, while he beats them to jar off the insects they may support. Finally he needs a note book and pencil and some gummed labels. No naturalist has any business to exist without the means of promptly recording exactly what he sees.

Where to Collect:

Specimens may be collected in all kinds of places: In the water, in the air, in the soil, beneath stones, logs, bark, fallen leaves, animal droppings, in the stems and trunks of plants and trees, in and on leaves, on animals, and in the household, stores, mills, and other buildings. No place should be neglected, as the different haunts will yield species which have different natures and structures. It is extremely interesting to collect some insects from the water and see how perfectly they are adapted to aquatic life by the natural

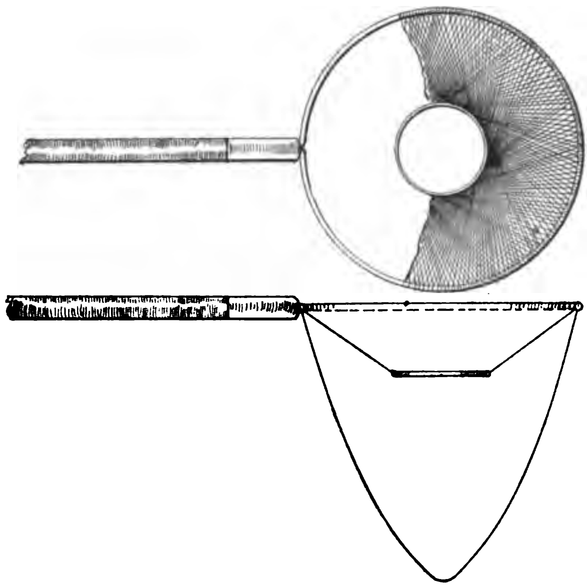


Fig. 5.—Water Net. Original design by H. A. Surface, Economic Zoologist. Original drawing by W. R. Walton, in Office of Economic Zoologist.

structures with which they are provided. Then note the adaptations of borers, diggers, climbers and flyers, etc., to their respective environments. The more varying the collection grounds the greater will be the number of specimens found and variations shown by them.

We find it very important to warn beginners or young collectors against the practice of taking long trips to collect specimens. A village garden presents as good a collecting ground as one will need, and there is no necessity nor is it advisable to wear oneself out by lengthy trips, losing time and specimens and in many cases ruining those collected by not taking care of them promptly. The collecting excursion should be conducted most leisurely. The collector should go to the region he wishes to investigate, equipped with bottles, net, umbrella or beating cloth, a strong knife, hatchet and trowel, make thorough investigations of the plants, decaying wood

and soil in that particular spot. When he goes collecting it should be for some definite purpose, to collect certain kinds of specimens that are known or supposed to be in some particular region, or to investigate some condition, phenomenon, or appearance of insects of certain kinds of plants. It is a good plan for young collectors to devote their attention on any one particular trip to insects injurious to one kind of plant, such as peach, apple, clover, grass or any other kind. Examination should be made of the leaves, fruit, twigs, trunk, bark and root, dissecting each when possible to see if it be tenanted. If immatured specimens be found they should be kept in breeding cages, on the natural food, to rear them to maturity.

Keeping Records:

It is not supposed that any one will know the names of all of his insects when he collects them, and this is not necessary, although it is essential for the collector to have some system by which he promptly keeps records of his specimens, and can make use of his notes at any time in the future for a proper study of the occurrence of the insects to which they refer. This is easily provided by a series of numbers. Give the same number to all specimens that were collected under the same conditions, i. e., at the same time, in the same locality, and on the same plant. As soon as the conditions change, as for example, in finding insects on another kind of plant, even in the same locality, give the second lot a new number. If one should change the collecting ground, as from swamp to a hillside, he should give different numbers to the insects collected in the different localities; and when he changes the date, even though going to the same place upon a subsequent expedition, he should give a new and distinguishing number to the material thus collected. There may be a great many different kinds of specimens thus bearing one number, but this number will show that they have all been collected under the same conditions. Each different kind represented by this number may be designated by a distinguishing letter added to the number, for each respective species or kind included under it.

Thus our collection No. 10414 is given to all specimens that were "Collected on the flowers of the Willow-leaved Milkweed (Asclepias incarnata) at Silver Springs, two miles north of Mechanicsburg, Pa., from 3 to 5 P. M., August 10, 1907, by H. A. Surface, Harrisburg, Pa. Weather bright, warm and sunny; light wind."

The different specimens are indicated as follows:

10414 a. Apis mellifica. Honey bee.
10414 b. Bombus affinis. Bumble bee No. 1.
10414 c. Bombus sp. Bumble bee No. 2.

10414 d. Pompilus sp. Digger wasp.
10414 e. Vespa sp. Yellow Jacket.
10414 f. Musca vomitoria. Blow fly.
10414 g. Diptera sp. 1. Unidentified fly No. 1.
10414 h. Diptera sp. 2. Unidentified fly No. 2.
10414 i. Diptera sp 3. Unidentified fly No. 3.
10414 j. Phymata erosa pennsylvanica. Ambush bug.
10414 k. Lygæid. Plant bug.
10414 l. Jassid. Leaf hopper.

In pinning them each species or kind collected under that number should be given its own distinguishing letter, as shown above. If it be found later that two or more species have been entered by error under the same letter it can easily be remedied by employing an unused letter for designating the specimens of the extra species. If so many kinds of species be collected at one time and put under one collecting number as to demand the use of all the letters of the alphabet the collector can either employ double or triple letters as "aa", "bb", or "aaa", "bbb", etc., or he can enter some of his collection under a new number, recording the same notes for it.

As all true scientific deductions are based on individual observations it is very important that these be recorded in a definite and systematic manner. The simplest way to make a record of what has been observed concerning any one individual insect is to use a small number following the letter used for the species attached to the collection number. Thus for example, in our collection No. 10414, the Bumble Bees of the species Bombus affinis are designated in our notes as 10414 b, which number and letter their labels bear; and among them were some individuals that were the basis of important scientific observations, and both the specimens and notes are indicated as follows: In this collection the individual Bumble Bees which called for personal notes or record are designated as 10414 b (1), 10414 b (2), 10414 b (3), and the notes concerning them show "specimen 10414 b (1) had so many pollen masses of Willow-leaved Milkweed attached to its legs that it did not try to fly but remained apparently clinging to the underside of the leaf of this plant." "No. 10414 b (2) was attacked by Assassin bug (Phymata, No. 10414 j), which tried to kill it but after one jump did not continue its attack." "No. 10414 b (3) was resting on the ground under the plant of Willow-leaved Milkweed with as many as five dozen stamen or pollen masses attached to one leg (See specimen)." Those individual specimens that are of such special interest as to justify notes concerning them should be collected and preserved in a separate bottle or box at the time of their collection, to prevent losing them or confusing them with others.

In the field note-book one should record every possible fact under the respective collection numbers, and if he afterward obtain the names of his insects, he may add these to the field notes, if he should choose. The one requirement above all else in the label of the specimens is not the name, but the number referring to the collecting note-book, thus giving in as great detail as possible the facts which were written at the time the specimen was collected. To keep specimens separated, which have different numbers it is important to have a number of empty bottles or small boxes into which the specimens may be transferred after they have been killed in the cyanide bottle, putting into each bottle or box only those which should be given one particular number or letter, and putting upon and also in the bottle or box the number and letter referring to the collection of the material it contains.

What to Collect:

In collecting specimens, some may be kept alive for study of their food, habits, eggs, larvæ, parasites, etc., and if immature or young specimens be collected some of them should be kept alive in order to obtain the adult or mature insects. Almost all descriptions and analytic tables or keys for determination are based on the adult forms. All insects with wings are "full grown" or mature. They never (excepting Mayflies) molt again nor grow larger after having attained the winged form. The little winged flies are not the young of larger individuals, nor are small beetles the "young ones" of larger beetles. Each represents a distinct species, and if all the species or kinds in a region are desired, the different sizes should be collected in order to obtain the different kinds.

Directions for collecting have been given in detail by Dr. C. V. Riley in a Bulletin of the United States National Museum, but as it is not available for many readers who have written to us for such colrections, we here quote some paragraphs freely from it.

Killing Specimens:

Specimens not intended for rearing should be killed immediately after capture, unless for each living specimen a separate vial or box can be provided. If a number of miscellaneous insects are put alive in the same vial, the stronger specimens will, in a short time, crush or otherwise injure the more delicate ones, or the predáceous species will devour any others they can master. But even where the specimens are killed immediately, the following rule should be observed: Do not put large and small specimens in the same vial, but provide a larger bottle for the larger specimens, and one, or still better, several smaller vials for the medium sized and very small specimens. The importance of this rule is recognized by all experienced collectors.

All insects in the mature form may be killed by dropping them into the cyanide bottle, but owing to the fact that the large, coarse insects, like the beetles, are likely to injure the delicate insects, like the moths, when put in the same bottle, expecially while the former are alive, it is best to have two or more cyanide bottles, and assort the insects in such a way as to keep them from injuring one another.

All insects in the immature or young stage, whether it be the egg, larva, nypmh or pupa, can be killed by putting them into dilute formalin or alcohol. The formalin should be about 5 per cent. strength and the alcohol about 50 per cent. strength.

Specimens from one kind of plant only, or deserving the same number, should be put into the same bottle. The collecting number referring to detailed notes upon them should be written on a slip of paper with pencil and put into the bottle at the time of making the collection, and also be written on the gummed label on the outside of the bottles. It is much more important to put a label in the liquid in the bottle than to write it on the outside where it may be lost and the collection can no longer be identified.

Of each of the immature stages there should be enough specimens collected to keep several alive in the breeding cages for the purpose of securing both sexes of the adult or mature form, and also to collect and preserve a few in each of the other stages as they progress in their course of metamorphosis.

In collecting the living insects a generous portion of the food plant should be collected with them and preserved in a tin or metal box until the return to the breeding cages. The specimens should be established at once in a glass vessel where they can be covered with cheese cloth and preserved with natural food and kept until they reach their maturity. It is very important to have some specimens of each of the immature stages to be preserved in liquid or by blowing.

There are several methods of killing insects, each having its own peculiar advantages and drawbacks.

Alcohol.—The use of alcohol will, on the whole, prove the most satisfactory method of killing Coleoptera or Beetles, many Hemiptera or Bugs, some Neuroptera, and larvæ of all sorts. Only the best quality of alcohol should be used, but it should be diluted with from 30 to 40 per cent. of pure water, the greatest care being taken to keep the alcohol as clean as possible. During the collecting a mass of debris and dirt is apt to be thrown into the bottle, and when this is the case the alcohol should be changed even during short excursions. At any rate, upon the return from the excursion, the specimens should be at once taken from the bottle and washed in pure alcohol in a shallow vessel. The larvæ and other material intended

for permanent preservation in alcohol should be transferred to suitable vials and the other material to be mounted cleansed with chloroform or acetic ether and then prepared for the cabinet. If inconvenient or impossible to mount the Coleoptera, etc., soon after the return from the excursion they should be washed, dried, and placed in pill boxes between layers of soft paper, or they may be replaced in a vial with pure alcohol.

Small specimens, especially larvæ, may be preserved in small bottles of alcohol if they be tightly corked. In order to permit the

Fig. 6.—Bottle of Alcoholic Specimen with Rubber Stopper, showing how a pin is used to let the air out of the bottle so the cork will fit tightly. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

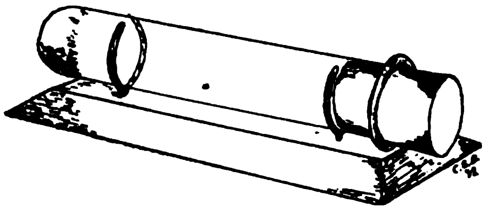


Fig. 7.—Board and clasps for holding bottle of alcoholic specimens placed horizontally. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

air to escape from such bottles, and insert the cork tightly, a pin may be held between the side of the cork and bottle, as shown in Fig. 6. These bottles may be kept either in frames, racks, or in boards with holes bored in them to receive the bottles and hold them upright, or they may be fastened on their sides by little blocks, and

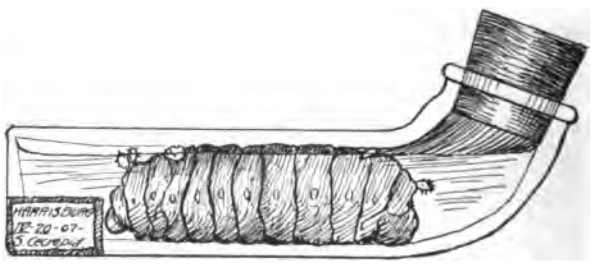


Fig. 8.—Bottle with up-turned mouth and flat side for holding specimens horizontally. Drawn by W. R. Walton in Office of Economic Zoologist.

kept in the cabinet in their proper places with other insects. Fig. 7 shows a device for holding such bottles of alcoholic specimens.

Figure 9 shows a compact form of bottle rack which is our own device for holding small bottles of specimens in liquid. It consists of a long narrow block of wood with a groove of the desired depth and width cut in the upper side. Into this groove the bottles stand and are held in place at the ends of the block by pieces of heavy paper glued over the ends. These blocks are pushed endwise into the shelves, and the numbers or names on the labels on the end shows what collection they contain.

Killing with the fumes of chloroform or ether (sulfuric or acetic), of benzine, or some other etheric oil, is often practiced and advocated by those who, for any reason, dislike the use of alcohol or object, on account of its poisonous nature, to the use of cyanide of potassium, and they are of especial value in the case of butterflies and moths, Hymenoptera or Bees and Wasps, and Diptera or Flies.

A small and stout bottle of chloroform or ether, with a brush securely inserted into the cork, will be found very serviceable. A slight

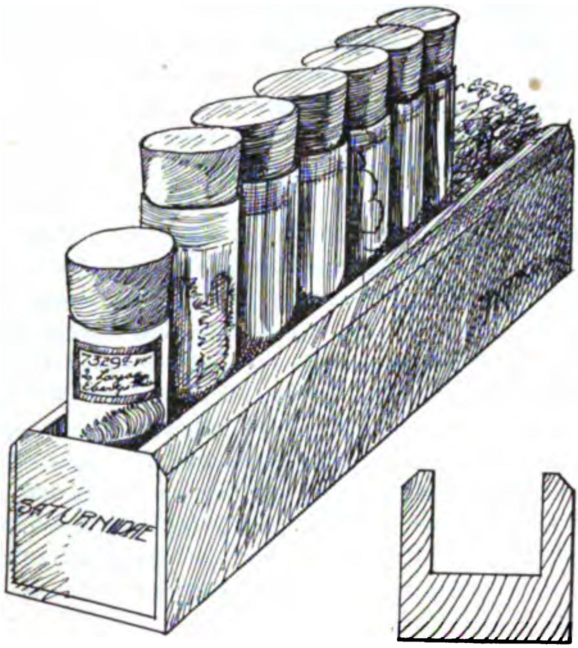


Fig. 9.—Bottle rack made of grooved block of wood. In use in collection of the Economic Zoologist. Drawn by W. R. Walton in Office of Economic Zoologist.

moistening through the air net will stupefy most insects caught in it, and facilitate their removal to the cyanide bottle; while a touch or two with the wet brush under the head and thorax, will kill the more delicate specimens outright, without in the least injuring them.

The method of killing which, of late years, has found most favor with collectors, is the use of cyanide of potassium. For killing large sized specimens they are simply put in what is known universally as the "cyanide bottle." This may be constructed as follows:

Take a two-ounce quinine bottle, or still better a shorter bottle, with a wide mouth; break a quantity of cyanide of potassium into pieces of convenient size (about a cubic centimeter); put these pieces into the bottle so that they form an even layer at the bottom; mix in

a convenient vessel a quantity of plaster of Paris with water just sufficient to make the mixture semi-fluid and then pour it over the cyanide so as to cover this last to a depth of about 5 millimeters. The bottle is then left open for an hour or two until the plaster is thoroughly dry. The walls of the bottle are then cleansed from particles of the plaster which may have splashed on them, and the bottle is ready for use. (See Fig. 1.) If not used too frequently, especially in warm weather, it will last for an entire year or longer. Bottles or vials of different sizes can be prepared in the same way, and a very small cyanide bottle which can be carried in the vest pocket will be found most convenient on all occasions. When the collected specimens have been removed from the bottle the latter should be wiped clean with a piece of cloth or paper. The surface of the plaster soon becomes dirty and, on account of the hygroscopic property of the cyanide, more or less moist, especially during warm weather. The cyanide bottle is, therefore, not well adapted for the killing and temporary preservation of small and delicate specimens. This difficulty can be altogether obviated by placing a circular piece of blotting paper, cut to fit neatly the interior of the bottle, on the surface of the plaster. This can be removed once a week or so, or oftener if it becomes necessary. It will frequently be advisable, also, especially in the collection of Diptera or Flies, Hymenoptera or Bees and Wasps, and other delicate insects, to put a strip of blotting paper partially round the inside of the bottle. This will absorb any moisture which may gather on the inside of the bottle and which would otherwise wet and injure the specimens. A similar result is attained by some collectors by partially filling the bottle with narrow strips of soft or absorbent paper to support and separate the insects.

We have found the use of benzine or gasoline very cheap and satisfactory for killing Lepidotera or Moths and Butterflies, as the largest are at once killed thereby without injury to their scales. Squirt it onto the specimen within the net or in the open air by means of a druggist's dropping tube.

Care of Fresh Specimens.

Upon the return from an excursion the specimens should be prepared for the collection as soon as practicable. If they have been collected in the forenoon they should be mounted not later than the same evening and those collected during an afternoon or evening excursion should be mounted the following morning, or, at any rate, before they get dry and brittle. Even specimens collected in alcohol should be attended to as soon as possible.

Specimens are taken from the collecting bottle, spread out on a sheet of white blotting paper and cleaned from adhering impurities

either with a soft dry brush or, in the case of species with hard covering, by washing them with chloroform, or ether, or benzine where necessary. Theoretically, the best way of mounting would be to pin all specimens, since the under side with its important characters then remains free for examination. Pins adapted for pinning even the smallest insects may be obtained, but this pinning is such a delicate operation and requires so much time that, considering the large number of small specimens that may be collected on a single short excursion, it is next to impossible to carry out this method, and, therefore, only the larger specimens need be pinned and the smaller may be glued onto the paper points described later. If the work is done with proper care all insects can be prepared for the cabinet so that both the upper and the under surface of the specimen may be examined without further manipulation.

Dr. Riley writes: "Many English entomologists use short pins, very much like those of ordinary make, and my late friend Walsh never gave up the custom, and most vehemently opposed the use of what he ridiculed as 'long German skewers.' But the only advantage that can possibly be obtained for the short pins is that they are less apt to bend, consequently more easily stuck into the bottom of boxes and require less room; while compared with the long pins, they have numerous disadvantages. Long pins admit of the very important advantage of attaching notes and labels to the specimen and render it more secure from injury when handled, and from museum pests in the cabinet, and on them several rows of carded duplicates may be fastened, one under the other, so as to economize room."

Pinning Specimens:

In pinning insects one should use regular insect pins, such as are shown in Fig. 10. These may be obtained from dealers in such supplies (such as Arthur H. Thomas, Williams, Brown and Earle, Philadelphia and Kny-Scheerer Co., New York City.) While regular insect pins are not essential in an amateur's collection, they add greatly to its attractive appearance and give more room for labels, but in making exchanges of pinned specimens it is practically necessary for them to be pinned on regulation pins. The pins should be pushed through the insect far enough to leave but one centimeter (slightly less than one-half inch) of its length above the back of the insect. Collections should be made neat and attractive by having the backs or tops of all specimens at the same level. This is best accomplished by the use of a pinning block or pinning gauge (Fig. 11) for the placing them at the proper position on the pin at the time of pinning. This block, which is very con-

venient to use, consists of a small plain block of wood of thickness equal to the desired height from the back of the specimen to the top of the pin, with a hole through which the pin is pushed to the desired position, after putting it through the specimen and turning it upside down, using the thickness of the block as the desired gauge. However, we mostly use as a gauge a bent pin inserted in a handle, as shown in Fig. 12.

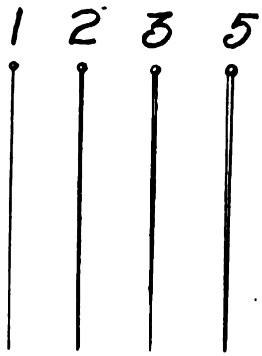


Fig. 10.—Insect pins of different sizes. No. 3 is best for small specimens and No. 5 for large. Drawn by W. R. Walton in Office of Economic Zoologist.

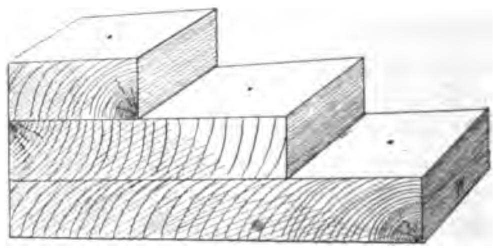


Fig. 11.—Pinning Block. Used as a gauge for pinning specimens. Drawn by W. R. Walton in Office of Economic Zoologist.

Insects should be pinned through the middle of the thorax, when, as is more generally the case, this portion (the mesa-thorax) is largely developed. However, beetles (Coleoptera) (Fig. 13 g) should be pinned through the right elytron or wing-cover, and bugs (Hemiptera) (Fig. 13 b) should be pinned through the scutel, or triangular piece behind

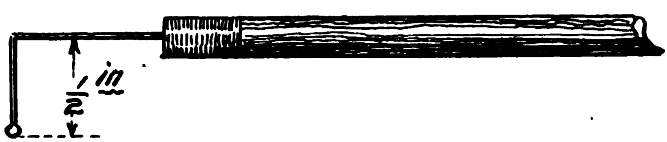


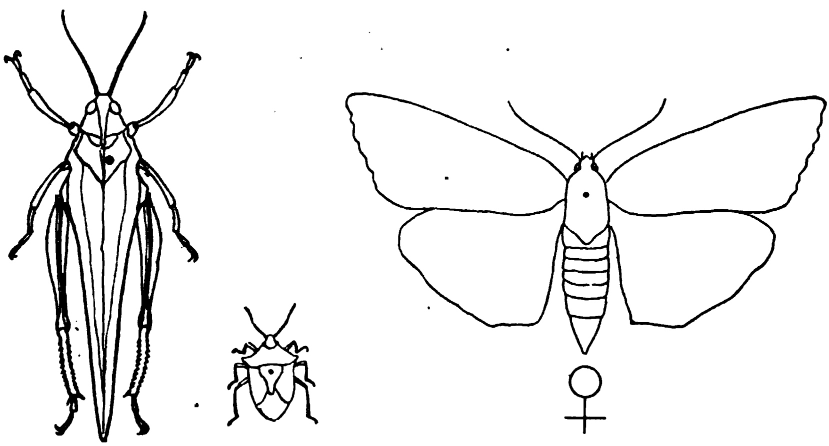
Fig. 12.—Pinning Gauge used for measuring proper height of insects on pins. Drawn by W. R. Walton in Office of Economic Zoologist.

developed. However, bettles (Coleoptera) (Figs. 13 f and g) should be pinned through the right elytron or wing-cover, and bugs (Hemiptera, (Fig. 13 b) should be pinned through the scutel, or triangular piece behind the thorax, the pin issuing between the middle and hind legs. The specimens look very pretty with all the legs neatly spread out, but for practical purposes it is better to let them dry in the natural, partly bent position. It is a saving of time and space, and the legs are not so apt to break. The legs must also not reach too far downward or they will interfere with the proper labeling and

the secure pinning of the specimen in the cabinet. Moreover, the antennae and legs must be brought into such position that they will not obstruct the view of any important part of the under surface and can plainly be seen. The pin should always project about half an inch above the insect to facilitate handling, and uniformity in this regard will have much to do with the neat appearance of the collection. In pinning very large and heavy insects on a No. 4 or No. 5 pin it is a good plan first to flatten the pin by a few blows of a hammar, in order to prevent the specimen from subsequently turning round on it.

Entomologists in this country uniformly pin their specimens on long insect pins, as shown in Fig. 10. Nos. 2 and 5 are the best pins

Fig. 13.—Insects of different orders showing where pin should be inserted:



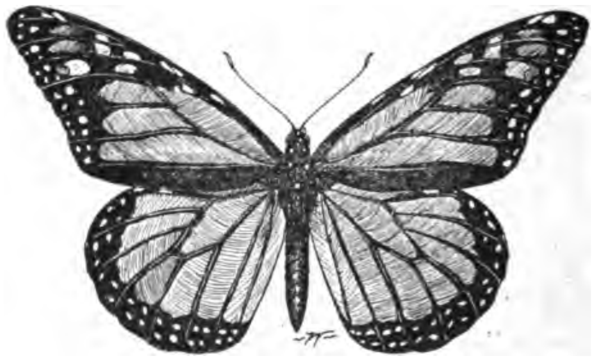
a. Grass Hopper. b. Pentatomid. c. Moth, Female.

for general use by beginners. The former are used for specimens of small and medium size, and the latter for large insects.

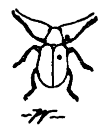
"In pinning specimens which have a flat or nearly flat under-surface and short legs (as in many Coleoptera and Hemiptera and some Hymenoptera, e. g., the Sawflies), the specimens are laid on a piece of cork, and held in place there with the fingers or with forceps. The pin is then pushed through the insect at the proper point, care being taken not to strike one of the legs or coxae and that the pin passes through the specimen in a vertical direction.

After the pin has been pushed through the specimen it is taken out of the cork and the specimen is pushed up to its proper height. This can be done either by holding the specimen between the fingers or by placing it on the upper edge of a thick book. A piece of cardboard provided with a small hole may also be used for this purpose. The perforations in ordinary sheet-cork, or the lapel of one's coat,

will answer the same purpose. In pinning Lepidoptera or Hymenoptera (Figs. c d and i) the specimen should lie lightly in the angle formed by the thumb and first two fingers of the left hand and the pin be carefully thrust through at the proper angle. In pinning all



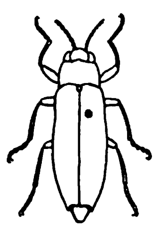
d, Butterfly.



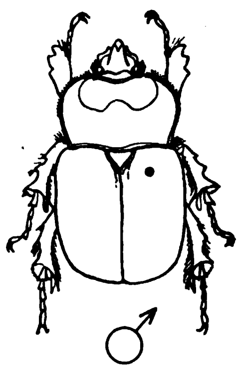
e, Leaf Beetle.

insects the pin should be so inserted that the insect is nearly at right angles to it."

The correct method of pinning specimens belonging to other orders than those sketched above is shown in Figs. 13 h and 13 i. The former of these represents the Flies, or Diptera, and the latter the Bees, or Hymenoptera.



f, Flat Headed Borer.

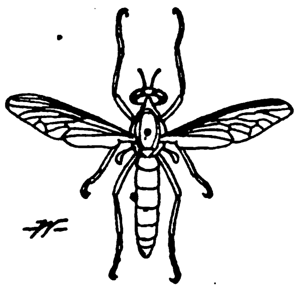


g, Scavenger Beetle, Male.

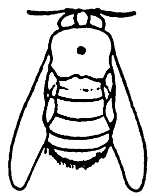
There are various ways of mounting very small insects, especially those that are too small to be pinned by putting a pin through them.

"One of the easiest ways of caring for minute specimens is to mount them on card points, which are triangular pieces of card. cut either with scissors or with a punch designed for the purpose.

An insect pin is thrust through the base of the card point and the specimen attached to its extremity with a little shellac, or gum. (Fig. 14. Or a fine pin may be taken, its head removed, the pin bent to a right angle, the larger end twisted with pliers tightly around a stouter pin near its point and pushed farther up on the supporting pin, and the specimen impaled on the upturned point of a smaller

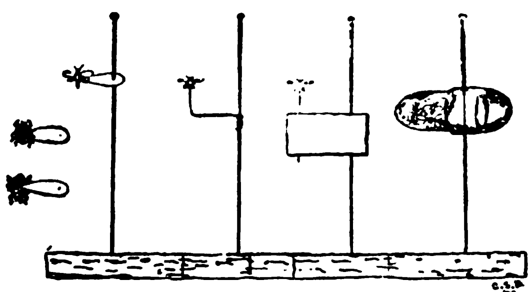


h, Robber Fly.



i, Bumble Bee.

pin. (Fig. 14 b.) Another way of accomplishing the same end is by cutting off the larger portion of the smaller pin and thrusting the point through a piece of cardboard or firm blotting paper (or cork), which, in turn, is mounted in a similar manner on a larger pin, and is then ready for the insect. (Fig. 14, between b and c.) Small species can also be put with labels in gelatine capsules, through one



a. b. c.

Fig. 14.—Illustrations of various methods of pinning and preserving very small insects. Paper point shown at the left. Gelatine capsule shown at the right. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

end of which a pin is run." (Fig. 14, c).—(Prof. E. P. Felt, State Entomologist, in Bulletin of the New York State Museum). Very small specimens can also be nicely preserved, dry, by putting them into small vials and with an insect pin through the cork of each; pin it just as though the little bottle were a large insect.

Storing, Packing and Shipping Specimens:

It is often desirable to store specimens in compact space or to ship them by mail in a manner in which they will not be broken easily, as when packed. For these purposes, folded papers are to be used. Especially moths and butterflies, which are delicate and easily broken when shipped with the wings spread, may be sent by mail without injury when placed in folded papers. Fig. 15 shows the method of folding papers to make envelopes or covers into which such specimens may be dropped, and the ends turned over for protection and keeping them in place. On the paper write the number, date and locality of collection and such other data as can be given. Where delicate specimens of moths and butterflies are to be sent to this office by mail, this is by far the best way of treating them. Even

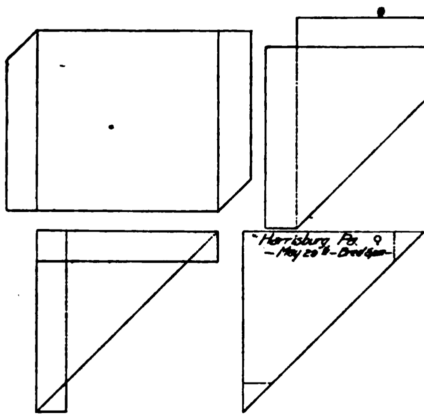


Fig. 15.—Folding Papers. Illustrating method of folding and shapes of papers for packing large winged insects. Drawn by W. R. Walton in Office of Economic Zoologist.

though they become entirely dry, they may be relaxed and spread at any time afterward in such a way as to become first-class cabinet material.

Spreading Specimens:

The wings of many kinds of insects should be spread before they are fit for the cabinet. This is especially true of butterflies and moths. It is best to spread them soon after they are killed and before they commence to become dry and stiff.

The legs and antennæ, or "feelers," should be properly set or put in the desired position, and if the insects be moths or butterflies, the wings should be spread or "set." This is done by using a setting board, (Fig. 16) which is made by nailing end strips under two pieces or boards of soft wood far enough apart to let the body of the insect sink into the groove between them. Beneath these two boards tack a strip of corrugated paper, cork, pith or blotting paper

PLATE XVI.—A Case Showing a Systematic Collection of Insects, Showing Representatives of all Orders and Many Families of Pennsylvania Species.
Collected, Prepared and Photographed in the Office of the Economic Zoologist of Pa.

PLATE XVII.—A Case Containing an Economic Collection of Insects, Showing Many Injurious Pennsylvania Species, with the Food of Some.

Collected, Prepared and Photographed in the Office of the Economic Zoologist of Pa.

to receive the pin bearing the insect. Pin it down until the body sinks into the groove between the boards, and then spread the front wings until the hinder edges or margins make a straight line across the body at right angles to it. (See position in Fig. 18.) Fasten the wings in position by strips of paper or ruled tracing cloth pinned over them to hold them down, and put the setting board aside, so that the specimens can dry for a week or more, and become firmly fixed in the positions in which they were left. We have found ruled tracing cloth to be the most satisfactory material for holding wings in position on setting boards while drying. The tracing cloth is

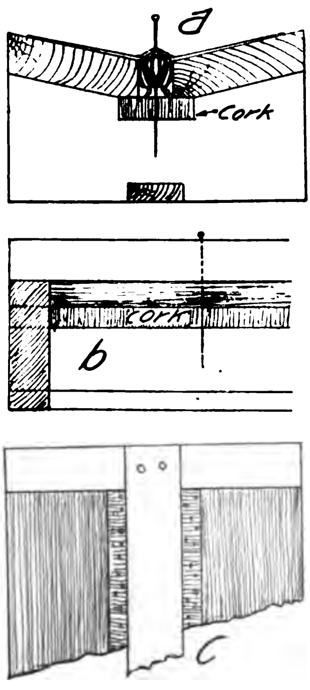


Fig. 16, a, b and c.—Spreading Board, showing method of construction. Drawn by W. R. Walton in Office of Economic Zoologist.

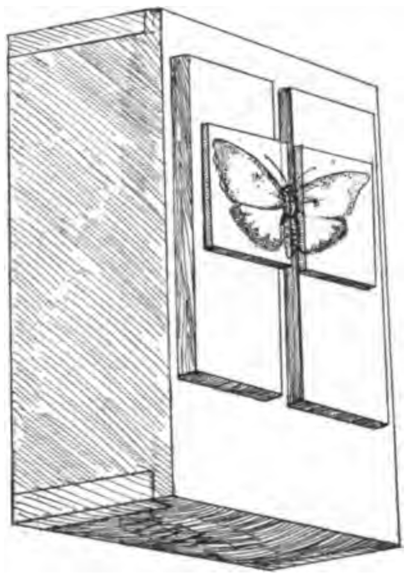


Fig. 17.--Paper box used for spreading insects, especially small moths. Drawn by W. R. Walton in Office of Economic Zoologist.

transparent enough to permit the position of the wings to be seen plainly, and the lines make it easy to set them at exact right angles (See Fig. 18).

"Another method of spreading requires still less material. The pin sustaining the insect is thrust through the pasteboard bottom of a small inverted box and squares of pasteboard, or thin wood of ample size, are laid on either side in such a manner as to be of the proper height. With a needle arrange the wings on the squares of pasteboard so far as possible and hold them in place by laying on

small pieces of glass. By tipping up one edge of the glass considerable rearrangement is possible, or by pushing the lower block gently, wings and all may be moved either forward or backward. This method is capable of producing good results, but the setting board is preferred by many. In spreading butterflies and moths the greatest care must be exercised not to rub off their scales. Members of the bee and wasp family, dragon flies and the others are more valuable after spreading and should be so treated when possible."—(Prof. Felt, in Bulletin of the New York State Museum.)

When insects are pinned, properly spread and thoroughly dried, put them for temporary storage into cigar boxes lined with corrugated paper or cork, or into tightly covered cases, and keep them away from dust and pests.

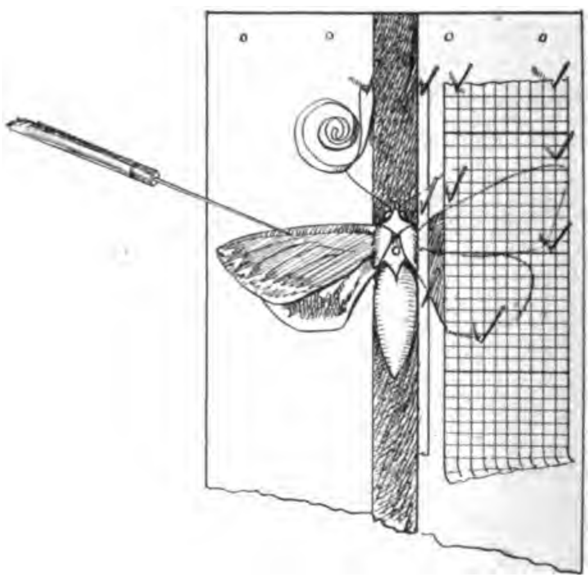


Fig. 18.—Spreading Board showing wings of moth under tracing cloth. Original design. Drawn by W. R. Walton in Office of Economic Zoologist.

Blowing Larvae: Small insect larvæ may be preserved nicely by putting them into a liquid composed of one part commercial formalin, 49 parts of grain alcohol and 50 parts water. This will keep them in good form without hardening and will also preserve their color as well as any liquid that can be used.

The larvæ can be preserved and pinned with the collection of mounted specimens by blowing them and drying them while they are inflated. This is done as follows: After the larva is killed, roll it gently with a pencil rolled with slight pressure from head to rear until the alimentary canal protrudes behind. Cut this off with

scissors a short distance back of the body. Lay it on a sheet of blotting paper and by gently pressing it from head to rear press out the liquids and body contents. Change it to a dry part of the blotting paper as often as necessary to keep it clean and dry, and remove its contents by rolling it gently with a lead pencil from head to rear.

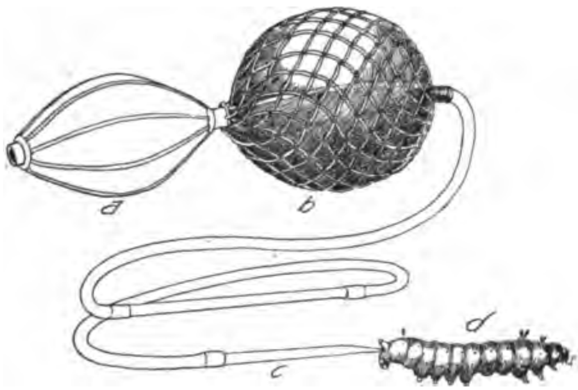


Fig. 19.—Inflating Apparatus for inflating larva. Original. Drawn by W. R. Walton in Office of Economic Zoologist.

By slight pressure (but not enough to crush it) it can be rolled so that nearly all of the contents are removed from the body, but the pigment under the skin, causing the characteristic spots and dots, and also the hairs covering it, need not be removed or destroyed. A little practice will render any collector quite proficient in this.

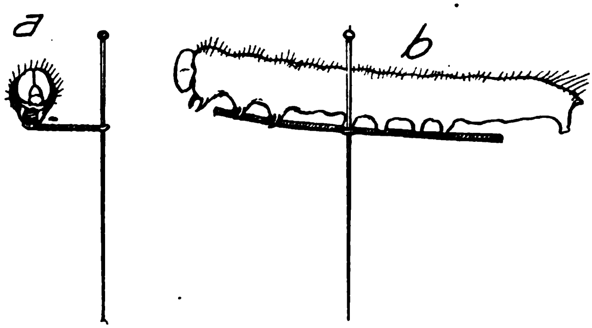


Fig. 20.—Inflated larva, dried and pinned. Drawn by W. R. Walton in Office of Economic Zoologist.

To blow it insert a small straw or quill in the posterior extremity and tie a thread tightly around it in such a manner as to prevent the larva slipping off the end of the straw. The best apparatus (Fig. 19) for blowing consists of a thin rubber bag connected by a short tube at one side with an air bulb for pumping the air into the

bag, and having on the other side a small tube which is to be slipped over the straw carrying the larva. By this rubber air bag a constant, steady pressure is maintained which will keep the larva inflated at a uniform condition until it is dry as will be discerned at once.

Inflating apparatus can be purchased from Arthur H. Thomas Co. Twelfth and Walnut Streets, Philadelphia, Pa., and the Kny-Scheerer Co., Fourth Avenue, New York City. However, if the collector can not afford the inflating apparatus he can use the straw, either held directly in the mouth or attached to a blow pipe. The process of blowing a larva is exactly like that of the blow pipe in maintaining a steady pressure, as in the blow pipe analysis. Any high school teacher of chemistry, geology or physics should be able to show how to blow a constant steady pressure through a small pipe for many minutes at a time and breathe without any inconvenience during the time.

The next step is to make a small drying oven by suspending on its side, over a flame, such as an ordinary lamp, a tin can, like an ordinary fruit can from which the one end has been removed. The larva, rolled fairly dry and clean and tied to the inflating straw. should be blown until it is distended to its normal size and then held in the drying oven and turned over and over to promote uniform drying, until it becomes dry and hard and does not "wilt down" when the pressure is removed. The drying should then be continued until the operator is certain that the specimen is entirely dry in all its parts. It can then be poisoned by spraying with alcoholic corrosive sublimate solution, and the end of the straw sticking into the body should be cut off a quarter of an inch from the specimen. The pin to hold it in the cabinet can be inserted through the straw (Fig. 20). The larva can then be pinned in the case beside the mature specimens of the same species.

Relaxing Dried Specimens: All work for adjusting specimens to desired heights, putting legs, wings, antennæ, abdomens (as of wasps), etc., in the desired position should be done while the specimens are soft and pliable or relaxed, as they are more brittle than glass when dry, and should not be handled or touched for any purpose whatever.

In preserving specimens that were preserved dry (i. e. not in liquid) when collected it is best to pin them as soon as possible after being collected; yet most kinds of mature insects can be kept dry and unpinned by putting them in a dry box, free from pests, providing they are not touched or shaken when dry, as they are then so easily broken.

After specimens have been collected and preserved in folded papers, as described in a previous part of this article, it is desirable

to relax them or soften them and spread them when time is to be found for such work. The relaxing or softening is easily accomplished by putting the specimens on damp sand in a closed jar or metal box or vessel and keeping it closed for a day or two. We have had excellent results in using glass cylinder jars, such as battery jars, lining the bottom and sides with a large sheet of blotting paper moist with water, and adding a few drops of carbolic acid to prevent molding of specimens. When the insects become sufficiently moist and soft that their wings and other appendages are easily put into place they may be pinned and spread on the setting board, just as in treating fresh specimens. The numbers referring to their collection should be kept with them at all times in order to avoid any error as to their origin.

Naming Specimens: The name is about the last feature of the specimen that receives attention excepting proper protection from pests. To name and classify specimens properly requires some knowledge of the terms used in classification and the use of analytic and descriptive literature, or access to named collections. The proper method for a young entomologist is to classify his specimens first to the great groups or orders, and second to the lesser groups or families by using some book for this purpose, such as Comstock's "Manual of Insects," and special literature on each group.

He should become sufficiently familiar with his specimens to be able to name the order and the family of any new species at once. To obtain the scientific name is a much greater difficulty. Descriptive literature or illustrations will be useful for this, or the specimens may be compared with named collections, or they may be sent to specialists for naming. In sending specimens to specialists it is best to send at least two of each kind bearing the same number and in good condition, giving him privilege to keep one set, or such as he may desire, for his trouble in naming them. Of course, if the collector is certain that the species are duplicated he can retain one set in his own collection and by giving the same numbers to those which he sends away the specialist can send him the names by referring to his numbers, but this method is not recommended for the reason that none but the specialist can be sure that any two specimens do or do not belong to the same identical species. The numbers used may be the collection numbers, which should always give the exact localities and dates of collection, with the name of collector. These facts are more important to the scientists than is the scientific name, for the reason that the latter name may be obtained by any one who knows the subject, but the desired facts as to the origin of specimens are to be obtained only by the record of the collector. Specimens sent to this office will be named upon terms indicated

above and retained in our Museum collection, but care should be taken to ship them so they will not be broken and time should be permitted for making the identifications. Other specimens will be sent in exchange if desired.

Writing and Placing Labels. All labels should be written with India ink or carbon ink. This is to avoid difficulty in the future from the fading or blotting of writing. One of our best friends and most enthusiastic collectors has recently written, "For two months I have been working hard, having been compelled to relabel my entire collection of birds and mammals, the ink having faded out, so as to have rendered the classification in almost every case unintelligible to the unacquainted." Even for specimens in liquids the carbon ink can be used without blurring by letting the writing become entirely dry before immersing it in the liquid. When this ink becomes thick dilute it with a little ammonia in water.

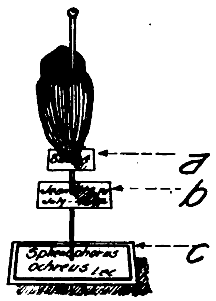


Fig. 21.—Manner of placing Labels, a, for Accession Number; b, for Locality and Date; c, for Scientific Name. Drawn by W. R. Walton in Office of Economic Zoologist.

The most important facts to record concerning the specimen are the date and locality of its collection, and the name of the collector. These may be written on a small label and pinned beneath the specimen, and upon the same label or upon a smaller one may be written the collector's accession number or the number that he uses to record the respective additions to his collection. The pin may also be put through this label, and when the name (genus and species and author) of the specimen is determined, this should be written on a separate label which can be held to the bottom of the cabinet, box or tray by the pin extending through it.

The specimens should be arranged in groups according to their respective orders and families, and the names of these groups should be written on larger labels, which should be placed in such a way as to indicate the limits of proper group. It is very important for

each beginner to see a collection arranged in the correct manner and observe the method of keeping data and placing labels. This varies with different persons, but every collector of natural history material of any kind should bear in mind that the most important facts to record permanently and keep with each specimen are those concerning its time and place of collection and the name and address of the collector. These are essential in making a study of the specimen in its relation to other creatures and to man, and only the one who collected it can give the necessary information. The name is not so important for the reason that this is not difficult to obtain at any time in the future, and a specimen without the scientific name may be of great value if it have the facts concerning its origin, but if these facts be not given it is generally absolutely worthless, even though the scientific name and classification may be correctly written. We recently went to see a large collection of mounted birds which the owner wished to sell, but as there were no records whatever, showing where and when they were collected, they were considered worthless for scientific purposes and no offer was made for them.

The exact date of the occurrence of an insect is particularly valuable for the reason that insects, like flowers, have certain dates when they appear and disappear, or change from one form to another, and the farmer and Economic Zoologist as well as the scientific collector are compelled to act in accordance with these dates. Beginners must not ignore the importance of keeping exact records of dates and localities when and where specimens were obtained.

Storing Specimens. The beginner will find old cigar boxes (Fig. 22) lined with pith, cork, or cork linoleum excellent for storing specimens and keeping them safe from pests. The museum pests that would otherwise attack them are deterred by the odor of the boxes and the specimens are thus kept uninjured for a long time. It is possible to use cases of nicer appearance and keep out museum pests by pinning among the specimens naptha balls into which hot pins have been sunken to support them in the cases. It is desirable that storage boxes be made as tight as possible and tongued and grooved, so that it will be impossible for pests to enter them and injure the specimens. There are several dealers in entomological supplies who sell glass-covered cases for insects at reasonable prices.

The best and most experienced collectors realize the necessity of protecting their specimens from injury by moths and beetles, to the extent that they take the trouble to poison them by spraying both the upper and under sides with an alcoholic solution of corrosive sublimate. A hand atomizer is used for this and the poison is dissolved in the alcohol and tested by dipping a black feather into

it. If upon drying, any white powder is seen upon the feather, more alcohol is added until the solution is of such strength that it is well saturated but will not leave a white deposit. This poisoned alcohol is then blown by the atomizer in a fine mist both over and under the specimens. We have known beautiful specimens kept many years in exposed situations after having been thus poisoned while on the other hand we have recently received several complaints of the destruction of cabinet insects by the museum pests. When these pests once enter a collection their presence becomes

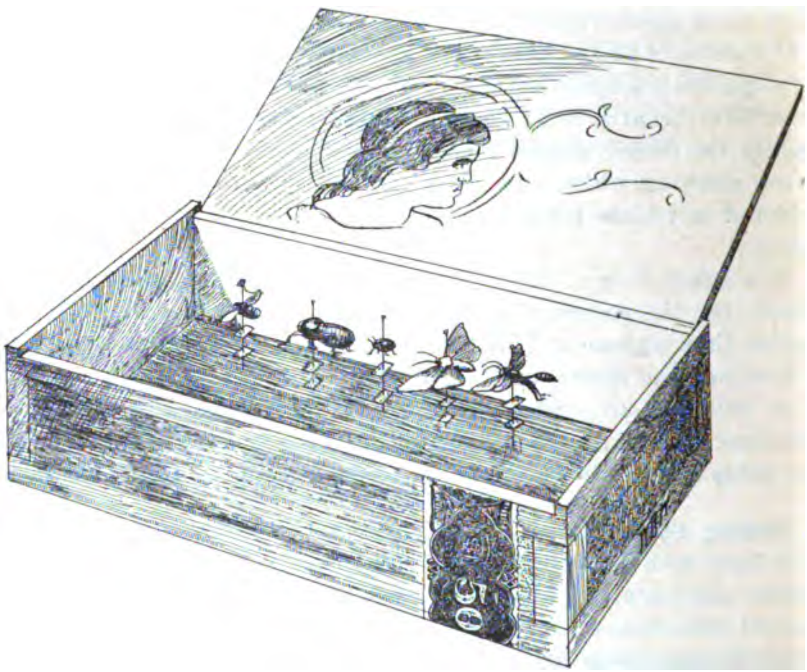


Fig. 22.—Specimens stored in Cigar Box. Drawn by W. R. Walton in Office of Economic Zoologist.

visible by a fine dust or powder beneath the specimens in which they are working. The infested specimens should be placed in a closed vessel and strongly fumigated with carbon bisulphide, or baked in an oven at a temperature that will not quite make wood smoke.

As all specimens are sure to fade if kept in a bright light, their cases should be provided with doors or curtains that will close and keep them darkened when not in use.

Individuals interested in entomology are invited to come and see our collections, and teachers are especially requested to bring their pupils on excursions to see the same.

A few properly prepared and labeled specimens will be sent by us free to any person in Pennsylvania engaged in making a collection for school, agricultural or other educational or practical public purpose. Also, in our collection are named and mounted specimens

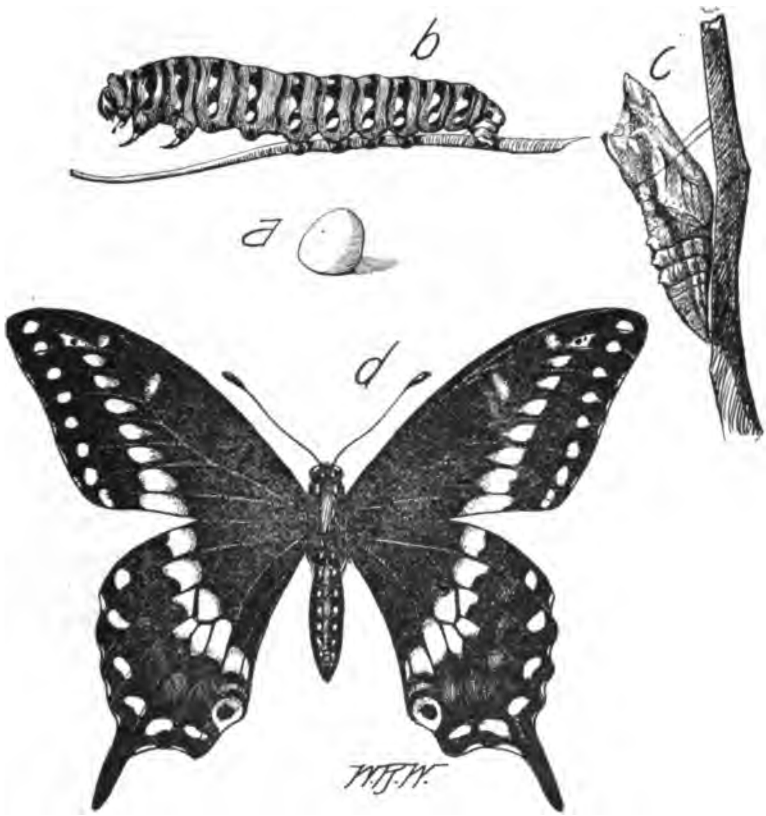


Fig. 23.—Drawing of Butterfly showing a, egg; b, larva; c, pupa or chrysalis; d, adult, the four stages of insect metamorphosis. Original drawing by W. R. Walton in Office of Economic Zoologist.

of Pennsylvania insects in first class condition to exchange with any person, in any country, for specimens of desired species, especially those of economic value.

What a Collection Can Be Made to Show.

The old style entomologist was one whose chief outfit consisted of a net and a bottle of cyanide or chloroform. His purpose was to procure cabinet specimens, particularly of the larger and more attractive insects, or of very rare species. He rarely paid attention

to them in their immature stages, not being greatly interested in their life histories, food plants, enemies or remedies, but merely desiring to collect specimens, either showy or very rare, stick pins through them, and label them with scientific names.

The modern entomologist sees in his study of insects an opportunity to exemplify and illustrate practically all the great laws of biology and of finding and studying the many apparent exceptions thereto. The greater the number of forms or species of living things belonging to any one Group, the greater is the variation there shown, and the more interesting should its study become. The multitudinous host of insects in this State, reaching 240,000 species, is such as to present types of specimens illustrating many great natural laws, with variations of many remarkable kinds.

A properly prepared collection will show not only the types of the various Orders and Families of insects known and collected, but will also show the great range of variations which these insects have been obliged to assume in order to maintain their existence where competition has been so keen that the slightest advantage in difference of structure or place or method of living may mean the continuation of that particular form or variety, while the slightest disadvantage may mean dropping out of existence, or being forced to find another haunt, place or method of living, other food, or method of protection, etc.

The modern Collection will consequently show the following:

(1) **Specimens of all species or kinds** found in the region where it is made, arranged in systematic order, or in the major and minor groups of Orders, Families, Sub-families, Genera, Species and Varieties, respectively. This will be called the Systematic Collection, and the specimens should be named with labels bearing both the scientific and common names. It will be used chiefly for comparison in naming other specimens that will be collected, and will consist almost entirely of adult or mature individuals.

(2) **The Stages of Insect Life.** In this collection will be found fewer species of insects, but they will represent the stages or steps in the life history or development of any one or more species of each Family or Order, if they can be obtained. They will exhibit such stages or steps of insect life as the egg, the very young larva or nymph, the older larva or nymph after once moulting, and again the older form or stage, after moulting or casting its skin again, until the different molts of the immature form (i. e., larva or nymph) in its process of growth are illustrated; then the pupa or chrysalis will be shown, with its cocoon or earthen cell or other means of protection, whether it be suspended by a few threads, as the chrysalids of many butterflies, or merely wrapped in leaves,

or otherwise; and finally the adult or mature insects of both sexes will complete this group of specimens, showing the stages in the life history of one or more species. In many cases the larvae will be found feeding upon plants, and these are to be put into vessels, called Breeding Cages, kept covered with netting, and supplied with fresh food until they undergo their various stages, and finally appear as mature, adult, or fully-developed insects. If the eggs be desired, it is generally best to keep the adult insects until the eggs are laid, when after having preserved in bottles of alcohol or formalin, or otherwise, one or more specimens in each stage, they can be arranged so that the series is complete, from the egg to the adult. It is much more easy to find the larvae of insects, as they are conspicuous by the holes they make in the leaves or other places where they are feeding, than to find their eggs, and for that reason it is recommended to begin a collection to show the stages or life history, with the larval forms, keeping them in breeding cages and preserving in small bottles of alcohol or formalin one or more specimens of the insect in each of its stages, as it progresses during its metamorphosis.

(3) Variations. The variations of many insects from the typical forms in their respective groups are of considerable interest, and can be shown plainly in any properly prepared collection. For example, the Mole Cricket is indeed a "Cricket" and would belong with the insects of that Family, yet it has lived underground so long that its structure has become greatly modified, its body elongate, its antennæ are very short and modified into special "feelers," as are its palpi or small threads around the mouth, and its front legs have become modified for the purpose of making a tunnel as does the Mole, until they almost exactly represent, in miniature, the front feet of the common Garden Mole. Not only in form do they resemble this animal's feet, but also in position in which they are held, and in the way they do their work.

Again, the moths of the night-flying winged insects (Nocturnal Lepidoptera) nearly all have wings, and fly readily from place to place in the adult stage, but the females of the common Tussock Moth, which are the adults of the hairy caterpillars with red, black and white hairs so generally devouring the foliage of shade trees along our streets, have become so accustomed to simply spinning cocoons on the bark, emerging from these and laying their eggs upon the old cocoons that their wings through disuse have become quite abortative and are only small vestiges indicating that they once had wings, but these are now entirely incapable of use in flight. The female Canker Worms are entirely wingless, and climb the trees to lay their eggs. Collections showing variations of in-

sects should include such specimens, and the collectors and students making use of such collections will find great interest in the study of the cause of such variations in relation to the life history or places and methods of living.

Again, the common Bagworm, which is so very abundant and destructive to foliage throughout the southern and eastern positions of this State, presents a peculiar feature, the female not even transforming into the form of a moth, but in the fall she remains in the same bag in which she fed as a larva, and this acts as a protecting cocoon. Her eggs are laid within a protecting envelope consisting of the crysalis shell and within the cocoon-like bag. The young escape from this when they hatch in the spring, and crawl to the foliage of the trees, where they feed.

Such peculiar variations in structures are readily shown by specimens, and collectors who can not obtain specimens of the species here named can find in their own regions others just as peculiar or interesting in practically all Orders of insects. However, if it should be desired to show such peculiar features as those represented by the Bagworm in a region where this insect does not occur, it is very easy to obtain specimens by exchange. Nearly all Collectors are glad to exchange specimens, and we can give the names and addresses of persons who will be pleased to enter into such exchange, or shall be glad to make exchanges from our own collections.

A peculiar variation in the life history of insects is shown in the common Sheep Tick, which can be picked from almost any sheep in this State. This insect while wingless is really a fly, and this shows at once the results of the loss of an organ, such as a wing, through disuse, and through living where it would really be in the way. Not only is the Sheep Tick a wingless fly, but it shows the further peculiarity of a remarkably modified life history. The parent lives in such place that she can obtain an abundance of food in the form of the blood from the sheep. She does not lay eggs but retains them until after they hatch, and even until after the larvæ have developed and transformed to the pupæ or chrysalids when they are laid instead of the eggs. The little dark, hard, seed-like objects, often found in the wool of a sheep, and to be obtained at almost any time by catching a sheep and examing it closely, are really the pupæ or chrysalids of the Sheep Tick, and have passed the first two stages of transformation within the mature Tick before having been laid.

(4) **Means of Protection.** There is no broader field of insect study than that of the means of protection of each insect in each of its stages. The eggs, for example, may be protected by being deposited in water, as in the case of Stone Flies and Black Flies; or

in the form of little rafts on the water, as do the Mosquitoes, the eggs of which are easily obtained at this time of year by permitting a large pan of water to stand in a shady place a few days, when they will be found like minute black balls of soot that have fallen upon it; or they may be laid on objects over the water, so that the young larvæ on hatching will readily drop into it, as does the Corydalis, which is the mature form of the Helgramite or Dobson; or they may be deposited in the soil, as do many Grasshoppers, Beetles, Ground Beetles, etc.; or they may be deposited in decaying wood, as do some Grasshoppers and Crickets; or in living wood, as the Cicadas; or just beneath bark, as the Tree-hoppers; or on bark the same color as themselves, as the Katydid; or on leaves of their own color, which renders them inconspicuous, as many moths; or they may be scattered singly and be so small as to escape notice, as butterflies; dropped loosely among fallen leaves, as the Walking-sticks; covered with water-proof varnish, as the Tent Caterpillars; and many other means of protection in the egg state alone, which can not be discussed here for lack of space, are to be found by the collector each day if he really keep his eyes open.

In the larval or second stage many variations of means of protection may be found and exhibited, among some of which are the following: Living in water, as the Mosquito; living in water beneath stones, as the Stone Flies; living in water beneath sand, as many Dragon Flies; living in water in little cases, as the Caddis Fly larvæ; living beneath the ground, as the Cutworms, Wireworms, Ant lions, and the larvæ of many Ground Beetles and flies, such as the Horse Fly; living in the stalks of plants, such as Stalk Borers and many others that are easily found by splitting the stalks of weeds and cultivated plants, and often bushes, such as elder or currant; boring in wood, as the Locust Borer; boring beneath bark, as the peach, apple and pear borer; living in the tissues of leaves, such as the Leaf Miner that makes little worm-like tunnels through the leaves; living in the roots of plants, like Clover-root Borers; living within fruits, such as Codling Moth and Curculio larvæ; living on vegetation but being of the same color, such as the Sphinx larvæ and many others; covered with spines or hairs, as many caterpillars and Beetle larvæ; throwing out offensive odors when touched, such as some of the butterfly larvæ, which can be found feeding on carrot, parsnip and celery leaves, and show their yellow horns when suddenly touched; carrying cases with them, such as Bagworms, some small beetle larvæ, and Caddis Fly larvæ; carrying their cast skins or exuviæ over them, as larvæ of some of the Leaf Beetles; living in tents, as the Tent Caterpillars; and other forms of pro-

tection in the larval state, which the collector will take pleasure in studying, and can devise means to show in his collection.

In the pupal state he will, for example, show such means of protection as the formation of cocoons, which may be fastened to twigs, as the Cecropia Moth, or laid entirely flat against the bark, thus being inconspicuous, as the Under-wings, or may be wrapped in leaves, which hang on the trees, as the Promethea Moth, or may merely fall to the ground among the fallen leaves, and there be concealed, as the Polyphemus Moth, or the pupa may be formed beneath the ground, as the Sphinx Moth or Hummingbird Moths, the Cutworms, Potato Beetles, etc., or it may be within the plant in which the larvæ live, as with the Clear-wings; or it may be suspended in some out-of-the-way place, as with many butterflies; or merely beneath the bark of fallen logs, boards, etc., in protected spots, as with many Beetle larvæ, and in fact, as most insects.

It is in the adult or mature stage that we find the most remarkable cases of protection, some of which are as follows: Imitating a green leaf, as the Katydid; resembling a yellow or dead leaf, as many Moths; looking like a flower, as some Moths and Butterflies; bright or conspicuous parts when moving but of such color as to be inconspicuous when quiet, as the Under-wing Moths, which are to be found on the bark of trees; assuming a threatening attitude, as the Stag Beetles; being provided with poison darts, as the Yellow Jackets, Hornets and Bees; mimicking or resembling stinging insects, as the Syrphus Flies, the Rove Beetles and the Clear-wing Moths; resembling spots or droppings on leaves, as many of the small light-colored Moths; assuming a green color, the same as the leaves on which they are found, as many Beetles and Flies; depending upon alertness, as the Grasshoppers, Leaf-hoppers, Butterflies, Tiger Beetles, Flies, etc.; being concealed in the ground, as the Ground Beetles, Ants, Termites, etc.; living in water, as aquatic beetles, Giant Water Bug, etc.; living on the water, as the Whirligig Beetles and Water Striders; having offensive odor, as most Heteroptera (Bugs), the Lace-wing, etc., offensive flavor or "taste," as Lady-beetles; living in nests, holes or trees, as Wasps, Crickets, Bees, etc., and other means of protection which the collector will observe and can exhibit.

(5) **Insect Organization.** The organization of those insects which are gregarious or live in colonies is always of great interest, and can be shown nicely in collections. For example, among the Termites, or White Ants, there are the Soldiers with extremely large heads and jaws, and workers with quite different appearance, as well as the winged forms or so-called kings and queens to be found in the spring of the year. By carefully excavating the nest of our

common White Ant, living so abundantly in woods, who can find the queen?

In a nest of Hornets at this time will be found the workers and the queen. The same can be said of the Yellow Jacket. In the nests of Ants will be found the workers, soldiers, queens, males, and often slaves of other species, besides other insects that may occasionally make their home with them.

One of the most interesting objects for illustration is the organization of the Honey Bee and its work. This should show the queen, the drone, and the workers, in their winged forms; pupæ of drones, workers and queen; and the larvæ of the workers and drones in their cells of respectively different sizes in uncapped comb and also in capped or sealed comb, the worker comb, the drone comb, the queen cells, the eggs in the worker cells and drone cells, the pollen or bee-bread, sealed honey, and both species of Bee Moths or Wax Moths in each of their stages.

The so-called Solitary Bees will be found of considerable interest, and their homes can be shown in the hollow plants in which their "nests" have been made, or in the wood that has been cut by the Carpenter Bee.

(6) **Means of Dissemination.** It is possible to show the means by which insects are disseminated from one locality to another, as follows: Primarily by their own wings, as most winged insects; upon infested wood that is to grow again, as scale insects; upon animals and other insects, as parasites; upon water, as insects found on running water; upon wind, as masses of cottony eggs, occasionally seen; by commerce, as those which feed in peas, beans and grains of various kinds; and by other means which will suggest themselves to the person who is a real student of the subject.

(7) **Food.** An exhibition of the food of various insects is of great importance and can be made without difficulty. Woods eaten by borers, such as the Goat Moth, or by the Locust Borer are easily obtained.

SPECIMENS RECEIVED DURING JULY, 1907.

Number.	Specimens.	Date—July, 1907.	Name and Address.
	Insects.		
9691	Fly galls on Grape (Lasioptera vitis),	1	E. P. Miller, Altoona.
9692	Rose Chafer (Macrodactylus subspinosus),	1	P. Ruppert, Saltillo.
9693	Moth larvae,	1	I. S. Spang, Kelly Sta.
9695	Wooly Aphis, Apple,	1	R. Norris, Phila.
9697	Lepidoptera pupae,	1	J. A. Weaver, Kinzers.
9699	Two-spotted Lady Beetle (Adalia bipunctata),	1	D. R. Jack, Apollo.
9700	Sphingidae,	1	M. L. Witherup, Emlenton.
9701	Shad Flies (Sialidae),	1	C. A. LeFevre, Lisburn.
9709	(c) 17-year Cicada (T. septendecim),	2	W. O. G. and H. K. West, Danville.
9712	(b) Cecropia Cocoon,	2	Mrs. S. N. Kranmer, Granville Summit.
9718	Cat Fleas,	2	——, Harrisburg.
9719	Tortoise-shell Beetle (Coptocycla clavata),	2	J. G. Overdorf, Mifflinburg.
9720	Rose Chafer,	2	E. P. Holland, Woodville.
9722	(a) Elm Scurfy (Chionaspis americana), (b) Aphids,	2	W. C. Mauser, Bloomsburg.
9723	Terrapin Scale (Eulecanium nigrofasciatum),	2	D. M. Wertz, Quincy.
9724	Oyster-shell Scale,	2	J. J. Buckingham, Scranton.
9728	(a) Eyed Elater (Alaus oculatus) (b) American Willow Sawfly (Cimbex americana),	2	J. Vallerchamp, Jr., Halifax.
9729	Insects,	2	G. R. Pritchard, Harrisburg.
9734	(b) Oyster-shell Scale,	2	R. E. Bohner, Loyalton.
9735	(b) Work of Flea Beetles,	2	S. Eberlig, Newburg.
9736	Rose Chafer,	2	H. B. Roland, Jr., Fox Chase, Phila.
9737	Beetle Larvae,	2	Miss M. L. Dock, Mt. Alto.
9739	Maple Aphids,	2	J. R. Snavely, Harrisburg.
9741	Rose Chafer	2	R. R. Smith, Linden.
9742	Oyster-shell Scale,	2	C. Bernley, Berwick.
9754	Aphids,	3	C. F., Pennsdale.
9755	(a) Aphids, (b) Elater Beetles,	3	A. M. Dickson, Sandy Lake.
9756	Hemispherical Scale (Saissetia hemisphaerica),	3	J. E. Reinhart, Newburg.
9757	Corn Root Webworms,	3	J. F. Haveryley, Wellsboro.
9758	Terrapin Scale,	3	J. K. Wilton, Taylorsville.
9759	Io Moth,	3	R. M. Musser, Curtin.
9760	Parasitic Wasp (Thalessa lunator),	3	I. G. Stone, Wellsboro.
9763	Maple Aphids,	3	Harry Rauch, Reading.
9764	Clear-wing Moth (Sesia sp.),	3	E. Kerper, Harrisburg.
9769	(b) Beetle larva,	5	W. Angus, Stoddartsville.
9776	Oyster-shell Scale,	5	R. S. Breed, Kingsley.
9778	Luna Moth,	5	E. Leopold, Pottstown.
9779	Lecanium,	5	S. Matdernass, Jr., Robesonia.
9780	Moths,	5	S. N. Beecher, New Milford.
9782	Rose Scale (Aulacaspis rosae),	5	Miss J. S. Hogue, West Chester.
9783	Rose Chafer,	5	H. N. Hosteman, Boalsburg.
9787	Larder Beetle (Dermestes lardarius)	5	A. L. Graffain, Indiana.
9799	Rose Chafer,		E. S. Gottshall, Huntingdon.
9805	Eyed Elater,	8	M. A. Feterman, Catawissa.
9806	(a) Moth Eggs, (c) Arctiid Moth (Estigmene acreae), (d) Army Worm (Leucania unipuncta),	8	L. B. Gilmore, Saegertown.
9807	(a) Crane Flies, (b) Beetle larvae,	8	J. B. McGrath, Houtzdale.
9808	(a) Moth larva,	8	I. S. Spang, Kelly Sta.
9809	Oyster-shell Scale,	8	N. J. Wells, Tunkhannock.
9810	Rose Chafer,	8	Dr. R. Hayes, Jersey Shore.
9812	Lady Beetle pupae,	8	D. Preston, Berwyn.
9813	Rose Chafer,	8	Dr. J. S. Funk, Easton.
9815	Coptocycla clavata,	8	L. W. Ritz, Lebanon.
9816	Thalessa lunator,	8	G. Thomas, Whitford.
9819	(a) Scurfy Scale,	8	A. Baley, Dallas.
9821	Cecropia Moth,	8	E. T. Lemont, Mechanicsburg.
9822	Aphids,	8	D. A. Smith, Steelton.
9823	Galls of Fly (Cecidomyia verrucicola),	8	J. Rieg, Jenkintown.
9826	Apple Aphids,	9	G. C. Comstock, Montrose.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9828	Maple Aphids,	9	J. A. Rex, Norristown.
9831	Lady Beetle larvae,	9	C. H. Rich, Woolrich.
9833	(a) Aphids on Elm,		
	(b) Lecanium sp.,	9	J. H. Patterson, Athens.
9834	(b) Thalessa lunator,	9	S. N. Baxter, Mt. Airy.
9835	Oak Worm Moth (Anisota senatoria),	9	J. R. Derr, Sunbury.
9836	Ants,	9	Miss M. M. Haine, Cheltenham.
9837	Cloaked Knotty Horn (Desmocerus palliatus),	9	J. G. Crichbaum, Chambersburg.
9838	Dobson Fly (Corydalus cornutus),	9	U. N. Ruduh, Cheltenham.
9842	(a) Common Sulfur Wing (Colias philodice). (b and c) Dragon Flies,	9	R. Martin and F. Fee, Harrisburg.
9851	Dobson Fly,	10	H. Simpson, Edgely.
9852	Rose Chafer,	10	Dr. Cott, Hecla.
9853	Maple Aphids,	10	E. R. Marvin, Pittsburg.
9855	Ground Beetle larvae,	10	I. L. Taylor, Smethport.
9856	(a) Grape Berry Moth,	10	C. E. Barr, Lancaster.
9857	Sphinx Moth (S. drupiferarum),	10	J. J. Krich, Monton.
9858	Wooly Aphis,	10	W. W. Polk, Phila.
9860	Beetle larvae,	10	A. Ryan, Hughesville.
9861	Wooly Apple Aphis,	10	Z. R. Schooll, Phila.
9862	Cherry Aphis,	10	B. F. McClellan, Harrisburg.
9863	Dobson Fly,	10	Post Office Dept., Harrisburg.
9866	Cecropia,	10	V. Harris, Harrisburg.
9867	Dobson Fly,	10	R. Martin and E. Kerper, Harrisburg.
9870	Aphids,	10	F. C. Bealor, Pittston.
9871	Magnolia Scale (Eulecanium cornuparvum),	10	A. W. Smith, Pittsburg.
9872	Ants,	10	W. B. K. Johnson, Allentown.
9878	Giant Water Bug (Benacus griseus),	11	J. L. Collner, St. Petersburg.
9879	Eggs of American Giant Water Bug (Belostoma americanum),	11	E. G. Bestedder, Trucksville.
9881	Work of Maple Aphis,	11	P. A. Small, York.
9882	Rose Chafer,	11	A. R. Schannauer, Wernersville.
9883	(a) Currant Sawfly larva, (b) Anisota eggs, (c) Moth larva,	11	G. R. Pritchard, Harrisburg.
9884	Terrapin Scale,	11	S. M. Rhone, Montgomery.
9885	Dobson Fly,	11	A. H. Rawson, Tioga.
9686	Long-horn Beetle (Xylotrechus colonus),	11	A. W. Young, Manheim.
9887	5-spotted Sphinx (Phlegethontius 5-maculata),	11	D. E. Zimmers, Bedford.
9889	Aphids,	11	W. R. Bairstow, Warren.
9906	(a) Sphinx Moth (Paonias excaecatus), (b) Oak Worm Moth,	12	M. Burt, Emlenton.
9907	(a) Grape Phylloxera, (b) Cottony Maple Scale (Pulvinaria innumerabilis),	12	Mrs. A. Rissinger, Columbia.
9908	American Giant Water Bug,	12	K. C. Mott, Meshoppen.
9909	(a) Work of Maple Aphis, (b) Cherry Aphis,	12	Miss Belle VanSant, Newtown.
9917	(a) Parasitized Cherry Aphids, (b) Bagworms, (c) Work of Jassids,	13	B. S. McClellan, Harrisburg.
9919	Cecropia Moths,	13	J. E. Hostetter, Pequea.
9920	Maple Aphids,	13	Dr. R. M. Krebbs, Pine Grove Mills.
9921	Io Moth,	13	Dr. D. W. Bortz, Esterly.
9923	Cynip Gall (Andricus seminator),	13	Dr. I. M. Weills, Harrisburg.
9924	Oyster-shell Scale,	13	Mrs. L. Leavy, Clearfield.
9927	(d) Dynastes tityus, (e) Jassids, (f) Lantern Flies,	13	K. Geist, Covington, Louisiana.
9933	25 species of Insects,	15	S. M. Beecher, New Milford.
9935	Rose Chafer,	15	J. H. Schrope, Hegins.
9936	Jassids,	15	J. G. Pentz, Greenville.
9937	Five-spotted Sphinx,	15	J. H. Hauck, Mercersburg.
9938	Long-horned Beetle,	15	E. F. Blewett, Dalton.
9939	Moth larvae,	15	E. D. Hammond, Sayre.
9942	(a) Regal Moth (Citheronia regalis), (b) Sphinx Moth (Phlegethontius carolina)	15	D. P. Shooks, Spring Mills.
9952	Stag Beetle (Lucanus dama),	16	G. Fungnieda, Womelsdorf.
9954	Eyed Elater,	16	C. L. Streamer, Phillipsburg.
9956	(a) Maple Aphids, (b) 15-spotted Lady Beetle, (c) Lady Beetle larvae,	16	J. F. Fryling, Sunbury.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9957	Butterfly larvae,	16	C. D. Wilrich, Moosic.
9962	Milkweed Beetle (Tetraopes tetraophthalmus),	16	A. I. Weckey, Eshcol.
9965	(b) Capsids,	16	D. W. Hazleton, Ambler.
9966	Aphids,	16	J. F. Hummel, Leeper.
9967	Pine Scales (Aspidiotus abietis),	16	Miss C. A. Creevy, W. Hampton Beech, N. J.
9969	June Beetle (Allorhina nitida),	16	E. Smith, Harrisburg.
9970	Flies,	16	J. Gibson, Harrisburg.
9971	Pigeon Tremex (Tremex columba,)	16	A. Barclay, Harrisburg.
9972	Paonias excaecatus,	16	J. H. Lovell, Glasgow.
9977	(a) The Cottony Maple Scale, (b) 15-Spotted Lady Beetle (Anatis ocellata),	16	J. F. Rohrer, Harrisburg.
9978	(a) Jassids, (b) Tree Cricket, (c) Lady Beetle larva,	16	J .B. Swaney, Hookerstown.
9988	Lady Beetle larva,	17	A. B. Miller, Barnesville.
9991	(a) Io Moth, (b) Rose Chafer, (c) Stone Fly,	17	J. W. Atkinson, Buckingham.
9992	Luna Moth,	17	L. C. Long, Listie.
9993	(a) Milkweed Beetle, (b) Dogbane Beetle (Chrysochus auratus),	17	J. F. Rupp, Shiremanstown.
9999	Stem-borer (Papaipema nitel.),	17	Dr. I. M. Weills, Harrisburg.
10005	Army Worm,	18	H. E. Wainwright, Pittsburg.
10007	Dobson Fly,	18	P. S. Tooker, Easton.
10008	Lecanium,	18	M. I. Blackford, Freeport.
10009	Cloaked Knotty Horn,	18	S. Caprio, Lock Haven.
10010	Regal Moth,	18	S. S. Risser, Florin.
10011	Grape Vine Tube Galls (Cecidomyia viticola),	18	H. H. Roemig, Allentown.
10012	Yellow Swallow-tail Butterfly,	18	A. B. Miller, Barnesville.
10013	Grape Sawfly Larvae,	18	C. E. Risser, East Berlin.
10014	(a) Dobson Fly, (b) Tachina Fly (Bombyliomyia abrupta),	18	T. Earl Williams, Kittanning.
10018	Io Moth,	18	E. Hollinger, Harrisburg.
10024	Geometrid Moth,	19	Miss Gladys A. Beebe, Logan.
10025	Oak Gall (Amphibolips inanis)	19	F. S. Andrews, Wellsboro.
10027	Abbot's Sphinx (Sphecodina abbottii),	19	W. P. Williams, Pine Sta.
10028	Sphinx Moth (Pholus pandorus),	19	S. Caprio, Lock Haven.
10030	Terrapin Scale,	19	W. J. Connolly, Scranton.
10044	Bag Worm,	20	T. C. Satttherthwait, Lansdowne.
10046	Butterfly, Red-spotted Purple (Limenitis ursula),	20	A. V. Miller, Barnesville.
10049	Scavenger Beetles (Histeridæ),	20	C. H. Rich, Woolrich.
10050	(a) Red-humed Apple Worm (Schizura concinna), (b) Variegated Cutworm (Peridroma saucia), (c) Oyster-shell Scale,	20	J. G. Overdorf, Mifflinburg.
10053	2-Spotted Lady Beetle,	22	J. S. Fay, Williamsburg.
10054	Bag Worm,	22	H. Smithson, Willow Street.
10057	Variegated Cutworm (Peridroma saucia),	22	W. M. Schrock, Sumerset.
10058	Webworms,	22	Mrs. J. W. Stang, Springville.
10059	Variegated Cutworm (P. saucia),	22	J. H. Kurtz, Bellwood.
10061	Dobson Fly,	22	A. C. Wentz, Hanover.
10062	Sphinx Moth (Sphinx chersis),	22	E. E. C. Gibbs, Huntingdon.
10063	Eyed Elater,	22	G. W. Brown, Sabula.
10064	Lady Beetle pupae,	22	The Republican, Pottsville.
10065	(a) Dobson Fly, (b) Dragon Fly, (c) Cherry Aphids,	22	A. F. Blewett, Dauphin.
10066	Moth Larvae,	22	J. Scharnbach, Germantown, Phila
10069	Cecropia Moth,	22	H. P. Templeton, Ulster.
10079	Lady Beetles, 4 species, Capsidæ, Tortoise Beetle (Cassida bicolor,	23	F. M. Bream, Gettysburg.
10080	American Willow Sawfly,	23	A. W. Buckman, Doylestown.
10081	Moth larvæ (Euthisanotia grata),	23	Mrs. J. Waugh, Washington.
10082	Long-horn Beetle (Prionus laticollis),	23	P. S. Tooker, Easton.
10085	Bagworm,	23	J. W. Prickett, Biglerville.
10096	Lady Beetle pupæ,	24	J. H. Zerby, Pottsville.
10097	11 species of Insects,	24	C. Strickland, Kingston.
10098	Cicada,	24	C. Strauss, Fredericksburg.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
10099	Moth,	24	G. H. Bedford, Nazareth.
10102	Stalk Borer (P. nitela),	24	B. S. Bowdish, Demarest, N. J.
10103	Variegated Cutworm (P. saucia),	24	G. D. Dixon, Slateford.
10104	Pigeon Tremex,	24	J. L. Arnout, Planesville.
10105	Cutworm (Noctua c-nigrum),	24	J. T. Couch, Carnegie.
10106	Beautiful Maple Borer (Plagionotus speciosus),	24	F. R. Mulford, Wellsboro.
10107	Polyphemus Moth,	24	Dr. F. L. R. Heichold, Clearfield.
10108	Bagworm,	24	G. B. Smitheman, Phila.
10109	Scurfy Scale,	24	J. Hopkins, Juniata.
10112	Stalk Borer (P. nitela),	24	R. M. Stocker, Honesdale.
10120	(b) Wood Nymph (Neonympha eurytus),	25	Robert Templeton, Ulster.
10121	(b) Beetles (Dermestidæ),	25	Anna K. Bewley, Forest Grove.
10125	(d) Bird Louse,	25	R. W. Wehrle, Indiana.
10130	Bagworm,	25	Miss G. E. Keller, Milroy.
10132	Neuroptera, Netted-winged Insects (Sialidæ),	25	J. T. Black, Glenhope.
10133	Flat-headed Borer (Dicerca divaricata),	25	C. A. LeFevre, Lisburn.
10134	Parasitized Sphinx larvæ,	25	B. M. Stone, Stull.
10135	Bagworm,	25	J. R. Snavely, Harrisburg.
10136	Bagworm,	25	Mrs. G. M. Lehman, Essington.
10139	Noctuid larva,	25	Miss C. B. Steel, Tioga.
10140	(a) Variegated Cutworm (P. saucia), (b) Zebra Worm (Mamestra picta),	25	Mrs. A. F. Hughes, Tioga.
10141	Chrysomelid Beetle larva,	25	Mrs. F. O. Steele, Tioga.
10142	Rosy Maple Worm (Dryocampa rubicunda),	25	G. C. Kiddel, Devon.
10150	Magnolia Lecanium,	26	Hon. G. B. Orlady, Huntingdon.
10151	Bagworm,	26	R. H. Feltwell, Phila.
10152	Dobson Fly,	26	W. A. Spencer, Factoryville.
10153	Abbots Sphinx,	26	B. M. Stone, Stull.
10154	Cottony Maple Scale,	26	S. N. Baxter, Mt. Airy.
10155	Long-horn Beetle (P. laticollis),	26	C. H. Bedford, Nazareth.
10158	Stag Beetle,	26	A. Barclay, Harrisburg.
10160	Larva of Under-wing Moth,	27	H. B. Eberly, Shiremanstown.
10163	Lightning Beetle,	27	J. M. Karns, Everett.
10165	Io Moth,	27	R. B. Bayne, Etters.
10166	Dobson Fly,	27	A. B. Miller, Barnesville.
10175	White-marked Tussock Moth,	29	J. A. B. Patterson, Beaver Falls.
10177	Luna Moth,	29	W. S. Huey, Allensville.
10179	Elm Scurfy Scale,	29	J. G. Gardner, Bryn Mawr.
10180	Scurfy Scale,	29	C. F. Hayes, Curwensville.
10181	White-marked Tussock Moth,	29	Mrs. F. R. Masters, Copaka Iron Works, N. Y.
10183	(a) Variegated Cutworm (P. saucia), (b) Aphids,	29	G. M. Richards, Erie.
10184	Imperial Moth (Eacles imperialis),	29	J. P. Gibson, Harrisburg.
10185	Scurfy Scale,	29	E. Welles, Wilkes-Barre.
10194	Twice-stabbed Lady Beetle,	30	J. E. K. Vaughan, Osceola Mills.
10195	Imperial Moth,	30	J. D. Denny, Columbia.
10196	Syrphid Fly pupæ,	30	R. G. Conklin, Asaph.
10200	(a) Spotted Grape Leaf Chafer (Pelidonata punctata), (b) Abbots Sphinx, (c) Sphinx larva,	30	F. Glass, Churchtown.
10202	Oyster-shell Scale,	30	W. H. Chase, Conneautville.
10203	(a) Flat-headed Borer (Buprestis fasciata), (b) Jassidæ,	30	Miss L. Depp, Brookville.
10204	(a) Polyphemus Moth, (b) Red-humped Apple Worm,	30	C. H. Rich, Woolrich.
10205	Io Moth larvæ,	30	J. H. Sherman, Montoursville.
10206	Prominent Moth,	30	L. Bebranges, Wayne.
10209	Aphids,	30	S. N. Baxter, Mt. Airy.
10210	Long-horn Beetle (Orthosoma bruneum),	30	L. M. Kerlin, Liverpool.
10211	Cicada,	30	H. P. Templeton, Ulster.
10213	(a, b and c) Dragon Flies, (d) Dobson Fly,	30	W. F. Hill, Chambersburg.
10215	2 species of Dragon Fly,	30	C. F. Anderson, Harrisburg.
10217	Long-horn Grasshoppers,	31	A. B. Miller, Barnesville.
10220	Regal Moth,	31	C. E. Tice, Knobsville.
10221	Variegated Cutworm,	31	J. D. Gill, Sr., Phillipsburg.
10225	Jassid,	31	Mrs. S. E. Givens, Easton.
	Invertebrates not Insects.		
9721	Mites,	2	J. S. Snelbaker, Dover.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9753	(a) Mites,	3	W. McVey, Bryn Mawr.
9759	(b) Spider,	3	R. M. Musser, Curtin.
9784	Centipedes,	5	C. H. Steiker, Pittsburg.
9806	(b) Spider Cocoon,	8	L. B. Gilmore, Saegerstown.
9899	Spider,	11	R. Martin, Harrisburg.
9965	Millipedes,	16	D. R. Hoffman, Mt. Gretna.
10031	(f) Cray Fish,	19	F. E. Keboch, Williamstown.
10076	(c) Millipede,	23	C. Richards, Easton.
10137	Apple-lead Blister Mite,	25	Miss M. E. Doane, Troy.
10176	Millipedes,	29	S. D. Boye, Coopersburg.
10182	Wood Tick,	29	J. W. Hege, Williamstown.
10197	Gordius,	30	L. K. King, Westfield.
10223	Gordius,	31	S. R. Rush, Dunn Sta.

The Specimens of Reptiles and Batrachians and of Birds and Mammals received during July will be acknowledged in the October issue of the Pennsylvania Zoological Bulletin.

THE

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OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

SUBJECT: The San Jose Scale.

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H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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CONTENTS OF THE OCTOBER ISSUE.

THE SAN JOSE SCALE IN PENNSYLVANIA.

As the season for spraying is now near it becomes appropriate to consider important points in the life of the San José Scale pest and particularly the best measures for its control. Most of these subjects have been treated briefly in previous issues of our Monthly Bulletin (especially for November and February), but the editions of those Bulletins are now almost exhausted, and as we are receiving many requests for such information, which is so seriously needed in this State at present, it is here given with the hope that it will be of some use to the thousands of persons whose trees are now being destroyed by the pests herein discussed. It is very important for all persons having trees to ascertain if the San José Scale be upon them, and, if so, to treat them thoroughly in the proper manner before the buds burst in the spring. Send to us twigs supposed to be infested, and we shall reply at once.

1. Names and Pronunciation.

The San José Scale has a scientific name which is indicative of its bad character. This is *Aspidiotus perniciosus*. The first or generic name refers to the shell or scale which covers the small soft-bodied insect, and its second or specific name properly refers to its pernicious effects. The common name of this pest is given from the old Spanish town in California, San José, where it was first introduced in the United States, although the citizens of California declare it is unjust to call this the "San José Scale," as it did not originate there but merely tarried a while on its way across the country. The pronunciation and accent of that city's name are in accordance with the Spanish language—"San," rhyming with "pan," and "Ho-zay." Thus the name is not "Jose" (rhyming with "rose"), as it is pronounced by many persons.

2. Origin and Introduction into Pennsylvania.

In giving the information necessary to successfully control this serious pest it is not necessary to discuss at length its origin or history, but these points are of some interest and worthy of mention. The native home of the San José Scale is the northern part of China, in the region of the Great Wall, where it lives on fruit trees and other woody plants, and has been known so long that there is no record of its origin, but it has been held in check there by its

natural enemies, so that it has not over-ridden everything in that country, as it has here. An attempt was made to introduce some of these enemies of the Scale into America, but only one species of lady beetle was brought into this country, while no doubt there are many other insects which destroy this pest in its native region. The introduced Chinese Lady Beetle was found to be so attacked by parasites, in turn, that it was destroyed by them and has not thrived in this country. False hopes have been raised concerning the destruction of the San José Scale by means of its natural enemies, and while this is at least worthy of experimentation, nothing has yet been accomplished that could be called successful in this direction. All economic entomologists agree that the only way to save our orchards and produce fruit is to prepare to fight this pest with modern insecticides and apparatus.

This pest was accidentally carried on plants from China to Japan, and in the effort to introduce a Curculio-proof Plum the Japanese Plum was brought in an infested condition to San José, California. About 1887 some enterprising nursery firms in New Jersey procured from California a number of Japanese Plum trees which were hoped to be Curculio-proof, but unfortunately were infested with a more serious pest than the Curculio, viz., San José Scale. About 1890 and 1891 this destroyer of trees was sent on nursery stock to a few localities in Pennsylvania, Virginia and a few other Eastern states, and it was not until after these trees commenced to grow in the orchards that the presence of this pest in Eastern United States was discovered. From that time it has gradually spread by various means mentioned later, until millions of dollars would be required to pay for the loss that our fruit growers have sustained from its ravages. During the past fifteen years all other fruit pests combined have not proven so destructive as has this one—by far the smallest of all in size, but vastly more abundant in numbers and more certain and deadly in effect.

3. Methods of Injury and Effects.

The San José Scale, like all other scale insects, attacks its hosts or food plants by sinking a long proboscis through the outer bark and into the sap-bearing inner bark and sometimes even into the soft wood. After having thus become fixed it is impossible for it to be freed without breaking off the proboscis and thus killing the scale. It commences at once to inject a poisonous liquid into the part of the tree attacked and this often results in conspicuous red specks upon the fruit and twigs. This is particularly noticeable upon plum, apple and pear and also upon the green tender shoots of peach branches. It differs from other scale insects in the fact

that its injected liquid appears to be more poisonous to the trees than is that of any other species of this large family of pests. We know that some insects bite and sting us with greater pain than do others, and there is all reason to believe that in the pests which attack vegetation by sucking some are more severe in their attacks upon the trees than others. The San José Scale, although certainly the smallest of such pests, is at the same time the most destructive as well, because of its immense numbers and severe effects.

The poison in the infested apple and pear trees can often be detected by scraping away the tough outer bark and disclosing the crimson or purple stain in the inner bark. After modifying the sap of the tree by this injection of poison, just as the mosquito modifies or slightly changes our blood by the injection of its poison, the scale insects suck the sap from the trees, utilizing it for their own sustenance. The mere loss of sap by the myriads of these pests is not nearly great enough to account for the very serious results upon vegetation.

The infested trees can be detected even at a distance by their appearance of gradual decline. The injured twigs commence to die at the tips, as nature tries to keep the tree alive at the center or toward the base. Often the interior of the heads will be bushy, but the long bare dead branches will be seen reaching out beyond them, thus telling of the effects of the scale. Toward the last stage of the life of the tree small shoots will often be found starting out from the trunk or larger branches, and sometimes strong sprouts will grow up from the roots.

The San José Scale especially fixes upon the growing fruit of the plum, pear and apple, partly because these fruits are hard and smooth and furnish a good situation, and partly because the twigs, of apples especially, are often densely fuzzy and do not prove to be good places for the scale to fix. It is owing to the fine fuzz of the peach that the scale does not generally attack the fruit of this tree to any great extent, as it does the fruits of the others just mentioned. Its appearance upon fruit of any kind need not be considered alarming, as it can not possibly spread from fruit that has begun to ripen, because it dies on such fruits, and can not reproduce from them.

We have been asked if it "would be safe to wash, peel and cook the fruits carrying the scale, and eat them without danger of being poisoned." Such precautions are by no means necessary. To eat infested fruits raw and unwashed, would be more disastrous to the scale than to the consumer. The latter need not fear any evil results. In this connection it should be explained that sometimes a careful spraying of the trees results in driving many scale insects

from the trees to the fruit, for the reason that they do not readily fix upon the branches or twigs covered by the Lime-sulfur Wash, and the leaves, being fuzzy, do not afford a good abiding place. Thus the only thing to be done by the insects is to fix on the fruit, where they may appear in considerable numbers, although possibly not found in great numbers on other parts of the tree. Repeating the spraying when the leaves are off will give better results on fruit of the same tree the following year.

4. Kinds of Plants Attacked by San José Scale.

The San José Scale is not a serious enemy of all kinds of trees and shrubs, as has been stated or published by persons who do not know the pest by personal experience, yet it does attack a greater number of plants than any other pest found in this State. We have had it sent to us on tomatoes, and have found it upon golden rod and other weeds, but this was not important as it had simply fallen upon such plants from fruit trees upon which it was abundant, and was forced to fix itself and try to exist upon whatever growing plant it chanced to be upon, as it had no choice and could not do otherwise.

A mere list of the kinds of plants upon which San José Scale has been found or may be found in regions where it is very abundant is comparatively useless and misleading from the fact that it is known to fix upon almost any kind of plant, tree, shrub or vine, to which it is carried by natural agencies when in the young and free-moving stage, but it will by no means thrive or multiply upon all of them. Just as there are certain plants that cattle will not eat excepting under the most dire necessity, while there are others they prefer, so are there trees, such as the sycamore, yellow or black locust, maples, poplars, and others that the San José Scale is known to attack when it is abundant in the neighborhood upon other kinds of trees on which it thrives well, but it will not develop upon these to an injurious extent. The cultivated plants upon which it is most destructive and which therefore should be watched for its presence, are nearly all varieties of fruit trees, excepting the following: Sour cherries, wild goose and similar varieties of plums, and the Kieffer pear (the Kieffer but rarely being attacked). It is not usually injurious to quinces, but at times is very destructive to quince and sweet cherry, and will attack all varieties of peaches and kill them in two or three years, while it destroys currant bushes, all varieties of apples, most varieties of plums and pears, the osage orange such as is used for hedging, flowering quince or Japan quince, mountain ash, shadberry or June berry, and some other varieties of

ornamental plants and shrubbery, but not all by any means. The conifers, commonly called evergreens, and most forest trees, are free from its attacks. In regions where it has long been abundant we always find a much larger variety of plants attacked by it than where it has started but recently.

Upon some plants, such as the grape vine, it will not generally be so abundant as to become the cause of alarm, yet at some places where the supporting trees have been killed by this pest and nearly all fruit trees were infested by it, we have seen grape vines killed by its attacks as they were climbing over infested trees. Had the vines not been in such close contact with trees upon which the scale multiplies so rapidly, they would not have been so seriously attacked. A mere list of plants that have been known to be infested does not give much useful information for the reason that it does not express the degree of injury to which each particular kind of plant is susceptible. We give herewith two lists, the first of which is of plants commonly or badly infested, the second is of those species only occasionally or rarely infested. Excepting for accidental omissions, all species of plants not mentioned below are free from danger by the San José Scale.

Plants Commonly and Rarely Known to be Infested with San José Scale:

(1) List of Hardy Trees, Shrubs and Vines Commonly Infested:

Acacia, sp.
Akebia, sp.
Akebia quinata.
Almond, (Prunus amygdalus).
Almond, Flowering, (Prunus Japonica).
Apple, (Pyrus Malus).
Apricot, (Prunus Armeniaca).
Ash, American Mountain, (Sorbus, sp.).
Ash, European Mountain, (Sorbus aucuparia).
Basswood, Linden, (Tilia, sp.).
Beech, European or Purple-leaved, (Fagus sylvatica).
Cornus Baileyi.
Cornus sanguinea.
Cotoneaster, sp.
Cotoneaster vulgaris.
Crabapple, (Pyrus, sp.).
Crataegus cordata.
Crataegus Crus-galli.
Currant, (Ribes rubrum).
Currant, European, (Ribes nigrum).
Currant, Flowering or Missouri, (Ribes aureum).
Cherry, Choke, (Prunus Virginiana).
Cherry, Sand, (Prunus pumila).
Cherry, Sweet, (Prunus Avium).
Cherry, Wild Black, (Prunus serotina).
Dogwood, White, (Cornus alba).
Elm, (Ulmus, sp.).
Elm, American, (Ulmus Americana).
Elm, European, (Ulmus campestris).
Gooseberry, American, (Ribes Oxyacanthoides).
Hawthorne, (Crataegus, sp.).
Hawthorne, English, (Crataegus Oxyacantha),
Hoptree, (Ptelea trifoliata).
Japanese Quince, (Cydonia Japonica).
Juneberry or Shadbush, (Amelanchier Canadensis).
Lilac, common, (Syringa vulgaris).
Lilac, Persian, (Syringa Persicæ).
Linden, American or Basswood, (Tilia Americana).
Orange, Sour, (Citrus trifoliata).
Orange, osage, (Toxylon pomibrum).
Peach, (Prunus Persicæ).
Pear, (Pyrus communis).
Pear, Sand, (Pyrus sinensis).
Plum, Beach, (Prunus maritima).
Plum, European, (Prunus domestica).
Plum, Japanese, (Prunus trifoliata).
Plum, Purple-leaved, (Prunus Cerasifera).
Plum, Wild Goose, (Prunus hortulana).
Poplar, (Populus, sp.).
Poplar, Carolina, (Populus deltoides).
Poplar, Lombardy, (Populus nigra, var. Ital.)
Privet, common, (Ligustrum vulgare).
Quince, common, (Cydonia vulgaris).
Quince, Flowering or Japan, (Cydonia Japonica).
Rose, (Rosa, sp.).
Rosa Carolina.
Rosa mucida.
Rosa Virginina.
Rosa rugosa.
Salix lucida.
Sand Cherry or Dwarf Cherry, (Prunus pumila).
Siberian Crab, (Pyrus baccata).
Scarlet Thorn, (Crataegus coccinea).
Snowberry, (Symphoricarpus racemosus).
Thorn, common, (Crataegus Crus-galli).
Walnut, Japanese, (Juglans Sieboldiana).
Willow, (Salix, sp.).
Willow, Laurel-leaved, (Salix pentandra).
Willow, Prairie, (Salix humilis).
Willow, Weeping, (Salix Babylonica)
Willow, Yellow, (Salix vitellina).

(2) Hardy Trees, Shrubs and Vines Occasionally or Rarely Infested:

Actindia arguta.
Alder, (Alnus, sp.).
Althea, (Hibicus Syriacus).
Arborvitæ, (Thuya occidentalis).
Ash, (Fraxinus, sp.).
Ash, White, (Fraxinus Americana).
Birch, (Betula, sp.).
Birch, Cut-leaved or White, (Betula alba).
Blackberry, common, (Rubus nigrobaccus).
Box, (Buxus, sp.).
Catalpa, common, (Catalpa bignonioides).
Cherry, Sour, (Prunus cerasus).
Chestnut, (Castanea Americana).
Chestnut, Horse, (Aesculus Hippocastaneum).
Cornus alternifolia.
Cornus Amomum.
Cornus candidissima.
Cornus circinata.
Cornus stolonifera.
Deutzia, (Deutzia, sp.).
Dewberry, (Rubus villosus).
Dogwood, Flowering, (Cornus Florida).
Eleagnus, (Eleagnus, sp.).
Elder, (Sambucus, sp.).
Eucalyptus, (Eucalyptus, sp.).
Euonymus, sp.
Fig, (Ficus Carica).
Forsythia, sp.
Globe Flower or Japanese Rose, (Kernia Japonica).
Grape, (Vitus, sp.).
Hackberry, (Celtis occidentalis).
Honeysuckle, (Lonicera, sp.).
Japanese Magnolia, (Cercidiphyllum Japonicum).
Jersey Tea, (Ceanothus Americana).
Laurel, Mountain, (Kalmia latifolia).
Locust, (Robinia, sp.).
Locust, Honey, (Gleditschia Triacanthos).
Maple, (Acer, sp.).
Maple, Norway, (Acer platanoides).
Maple, Sugar, (Acer saccharinum).
Maple, Weir's Cut-leaved, (Acer sacc.).
Mulberry, (Morus, sp.).
Mulberry, Weeping, (Morus, sp.).
Ninebark, (Physocarpus opulifolius).
Orange, (Citrus Aurantium).
Pecan, (Hicoria Pecan).
Persimmon, (Diaspyros Virginiana).
Photinia villosa.
Privet, California, (Ligustrum ovolifolium).
Raspberry, Red, (Rubus strigosus).
Rhodotypos kerrioides.
Sassafras, (Sassafras officinale).
Smoke Bush, (Rhus cotinus).
Sorbaria sorbifolia, (spiraea sorbifolia).
Spiraea, (Spiraea, sp.).
Spruce, White, (Picea alba.).
Sumac, (Rhus, sp.).
Silver Thorn, (Eleagnus longipes).
Virginia Creeper, (Ampelopsis quinquefolia).
Viburnum, sp.
Walnut, Black, (Juglans nigra).
Walnut, English or Persian, (Juglans regia).
White Rod, or Appalachian Tea, (Viburnum cassinoides).

5. Description and Life History of the San José Scale.

The living San José Scale insect is a minute, soft, lemon-yellow object or insect, concealed beneath a very minute black, flat-conical protecting scale, which is waterproof, and which is recognized in examination under a microscope by its distinguishing circular shape and black tip at the exact center, with a very small ring around this point. In the winter it is about three-fourths grown and remains in this condition until the warm weather of spring comes, when the insect injects more poison into the growing layer of the tree or shrub and sucks sap for its nourishment. It grows and its scale enlarges to nearly the size of a pin head and becomes of a brownish color rather than black, as in winter time.

From the 10th to the 15th of June the first young San José Scale insects appear. To the unaided eye they look like the most minute specks of yellow corn meal, but under a microscope they are seen to be oval in shape and have six legs and a pair of antennæ, as have other insects. They crawl about on the bark and leaves or fruit rather rapidly for such minute creatures, and may migrate for a distance of several feet from the parent that gave them birth, or they may fix very near her, even overlapping her shell. They exist in this young and free-moving stage only one or two days, or long enough to find a suitable place to sink their long whip-lash tongue or proboscis through the outer bark into the cambium or growing layer, or often into leaves or green fruit, when they commence to secrete a waxy covering, which comes through the pores of their skin. At first this is white, and perfectly circular, with the charac-

teristic little central point. This is their second stage or first fixed stage, and they are now known as "white sets." In this stage while not nearly as delicate and easily killed as they were when young and free-moving, they are yet more tender than at any later time. They inject poison into the part of the plant where they are fixed, suck out the modified sap, and grow, but can never again free themselves from this place, nor at any time let loose and move to another place, nor be scraped off and live. In the course of a few weeks they reach the third or black stage, described above as "the winter resting condition," and continue to grow until they attain the full size and brownish color of the adult scale, which is in about a month or less from their birth, when they soon commence to bear living young and continue this at the rate of several per day for another month or more. This kind of life history is continued until about the first of December. We have seen the free-moving young on fruit trees in orchards of this State as late as the fifth of December. During the winter those die which are not old enough to reach the properly protected resting stage, and also all of the old or full-grown individuals die then. Consequently, each winter as many as fifty per cent. may naturally be found dead upon a tree, but this does not indicate that severe weather is destroying any unusual number of them, nor does it show any gratifying decrease of these pests. Their multiplication is so rapid that it is estimated (U. S. Bulletin No. 3, page 44) to be possible for an individual to become the ancestor of 3,216,080,400 in one season. Since they multiply so rapidly, any agency or insecticide that would leave five per cent. of them alive upon the trees would be decidedly ineffective in holding them in check.

The males of the San José Scale are smaller than the female and undergo complete metamorphosis, or become winged in the fall. They then occur as exceedingly small, two-winged insects. The young insect may live and develop for about thirty days, more or less, according to temperature, before it commences to bear young, but the process of reproduction is so rapid that in one season one individual may become the ancestor of over three billion. Thus it is to be seen that this pest differs from the Oyster-shell and Scurfy scale and some other species of scale insects in the fact that it bears living young, while they lay eggs.

While the young scale insects are active they are, of course, unprotected, and are very delicate and easily killed. This was explained in detail in our June Bulletin for this year, Vol. IV, No. 2. Mild contact insecticides, such as dilute soap solutions, tobacco decoctions, oil emulsions, etc., which are used for plant lice, will also kill the young scale insects, but will not kill the adult or parent that is

treated at the same time with the same material. Our experiments have shown that it takes twelve or fourteen applications of contact insecticides at intervals of two or three days each to kill all the young scale insects as they appear and also to exhaust the reproductive capacity of the parent. The mature insect is covered by a thiner scale during the summer time, and thus is less protected and more easily killed than in the winter. We have tried repeated experiments with all kinds of insecticides, and have found nothing that will kill the adult or mature San José Scale while the green leaves are on the trees without also destroying the foliage. Of course, plants that are not bearing fruit may be treated with an insecticide so strong as to kill the scale insects, even though the leaves be taken off, but this could not be done every year, as it would soon result in the destruction of the plant.

Reproduction is continued until very cold weather, but the young that are born late in the fall die during the winter. When a tree has become so badly infested that it dies, its scale pests die with it. Also, when infested branches are trimmed from trees the San José Scales that are fixed upon these branches die as soon as the sap ceases to flow, and there is not the same necessity for burning these at once that there is for burning branches infected with fire blight or twig blight from which the disease germs are likely to spread at any time.

6. How and When Carried or Spread.

The methods of disseminating or carrying this insect from place to place should be understood by all persons who are growing trees or shrubbery. In order to get these points clearly in mind it is necessary to understand the life history of this pest as given in the previous section of this aricle. (See No. 5.) It should be kept in mind that the insect is able to move of its own accord only during the first day or two of its life, and it then fixes or fastens itself to bark, leaf or green fruit, and after a scale insect is once fixed it can never free itself nor move to another point. Thus it can be understood that the fixed or adult San José Scale is never carried or spread in such a way that it will live in its new quarters excepting when it is on wood that is going to grow again. In other words, the scale, when old enough to be fixed, is carried from place to place only upon plants that are to be transplanted or upon cuttings, buds, scions or grafts, but never upon fruit.

While the scale will be found upon ripe fruit it does not feed upon fruits after they commence to ripen, and hence does not multiply on them and is not spread while upon fruits that are ripe. It is perfectly safe to ship from one part of the country to another any

fruits that are infested without the least fear of danger in disseminating this pest, because it cannot free itself from the green fruits upon which it is fixed and does not live upon ripe fruit. After years of experiments with infested fruits of all kinds obtainable, we are prepared to say that we have never been able to obtain young scale insects from parents that were upon fruits which were commencing to ripen or mature. This shows the injustice of the laws of Oregon and of some of the European countries which attempt to prevent the introduction of the San José Scale there by the prohibition of the importation and sale of American fruits if infested and the confiscation and destruction of all shipments of fruits which have among them even a very few specimens of this scale insect. Such laws are but useless restrictions, as they are evidently based upon ignorance of the fact that the scale can not be carried into any country by such means.

After an infested tree is once planted in an orchard it is solely in the young or free-moving state this pest passes or is carried from tree to tree, unless infested cuttings, such as buds or grafts be used. To prevent its spread upon such cuttings these should be placed in a vessel that can be tightly closed, like a wash boiler, and fumigated with Hydrocyanic Acid Gas or Carbon Bisulphide. The means of carrying the young insects are various, as they are known to be transported by any agency that will bear them from one tree to another. Chief among these agencies are birds, upon the feet of which the young insects may crawl and be carried to a distant tree. Proof of this is found in the facts that frequently the infestation starts in that part of the tree where a bird's nest is found, and that the pest is more uniformly and extensively distributed where certain birds, such as the English Sparrow, are most abundant. Some persons have used this as an argument against the American Robin, but such reasoning is not proper, because the young scale is liable to be carried upon the feet of any kind of bird that will alight upon an infested branch, and it is also carried in a great many other ways besides by birds. Thus, if all the robins in the State were destroyed it could not perceptibly lessen or check the spread of the San José Scale.

This pest, when young, is also carried upon larger insects, such as grasshoppers, June bugs, and other beetles, flies, bees, etc., upon which it may crawl. A large and varied collection has been made of insects of larger size upon which this little pest has been actually found at the time of collection. It is also carried from tree to tree by squirrels, cats and other animals that may climb an infested tree and get the young free-moving scales upon their feet or fur and subsequently climb an uninfested tree and leave the pests there. They have also been carried upon the clothing of workmen passing

from tree to tree, and also upon larger animals, such as horses and cattle that walk beneath the infested trees and receive the pests dropping upon them and later accidentally brush them on other low branches. These pests when in the young state are also carried by the wind upon leaves or twigs that may be broken off, especially during storms, and we have positive evidence that they are disseminated by the wind in the fact that we have often found infested trees on the leeward side of one that originally had the scale, while on the windward side they were free from it. During the past year this feature was especially noticed on nursery stock grown in the vicinity of older fruit trees that were infested. The San José Scale is undoubtedly carried short distances through the air during the time it is young and free-moving, just as grains of dust or sand are carried, but not to the great distances that are sometimes believed.

Where the branches of trees intertwine it is possible for the San José Scale to crawl from one tree to another, and it often does this. Grape vines running over varieties of trees that are badly infested, such as peach, plum, pear and apple, are often found killed by the San José Scale, while they would not be seriously attacked if away from such trees, where the young pests could not freely crawl to the vines. There is absolutely no danger of the young San José Scale crawling down the tree and over the ground to other trees, because their tendency is to stay on the living wood or seek at once a bare spot where they can find a suitable place to fix, feed and live. Their occurrence upon the feet of birds is the result of short and accidental journeys rather than long and apparently premeditated migrations.

7. Why is the San José Scale so Destructive?

The following are some of the reasons why the San José Scale is so much more destructive than any other of the dozens of species of scale insects found in this State:

(1) It injects the most deadly poison into the trees. Its presence on young peach bark and fruits of nearly all kinds is generally shown by a large red blotch surrounding each scale and indicating the injected poison. By scraping off the outer bark of an infested pear limb the red blotches caused by this severe poison are plainly seen in the green bark and wood.

(2) It is so small (our smallest scale insect) that it is not observed, and its presence is often not suspected until its fatal effects are seen in the dying trees. It is then too late for any but the most radical remedies, intelligently and properly applied.

(3) It multiplies so rapidly that it soon covers a tree and spreads readily to others. According to the publications of the U. S. Department of Agriculture, one of these pests may become the ancestor of as many as three billion two hundred and sixteen million (3,216,000,000) in one season. Other common scale insects, such as the Oyster-shell or Scurfy, do not produce more than 600 descendats in a single season.

(4) Its ability to feed on many kinds of woody plants (not all species) makes it possible for it to spread more rapidly over a wide area, by being carried from one kind of tree or shrub to another, just as fire spreads only where there is combustible material.

(5) It multiplies by bearing young instead of laying eggs (as do most other species of scale insects), and as these do not appear at one time or in one brood and of one age, but at intervals of a few hours between each during the entire season, from June to December, and they spread by natural agencies only when young and free-moving (during their first two days), the San José Scale consequently spreads by natural means during nearly six months. However, the others such as the Oyster-shell Scale and Scurfy Scale, which lay eggs and hatch at one time, appear in broods and there are thus only a few days during each year when they are young and free-moving, and at which time they are spread from tree to tree by the agencies that carry them.

(6) They are so small that they are not large enough to nourish and sustain the same kinds of destructive internal parasites that hold in check nearly all other species of scale insects.

(7) They have been imported into this country without their natural enemies, and we have no insects or other creatures that feed upon them to a sufficient extent to prevent their exceedingly rapid increase and spread.

(8) The native home of the San José Scale is the northern part of China, which is naturally a cold country in the winter time, and as a consequence this pest is able to endure our severe winter weather without having its numbers greatly reduced by freezing.

(9) The San José Scale is so hard to kill by insecticides that these materials must be strong enough seriously to injure the foliage of trees in order to kill the old or fixed scales, and for this reason they must be treated when the trees are dormant or not in leaf, and can not be suppressed by spraying while leaves are present, as can many other species of insects. While spring spraying in May will kill the Oyster-shell and the Scurfy Scales, because they are then all in the young and delicate stage and easily killed by mild contact insecticides, such as Whale Oil Soap in water, or Kerosene Emulsion, dilute, the San José Scale insects are to be found in all possible

stages of development at all times of year after the appearance of the first young in the early part of June. Therefore, the spraying that would kill them in the young stage would not destroy all the San José Scale, because at the same time there are living old ones which would not be injured by the same material.

8. Natural Enemies of San José Scale.

Most other scale insects in this country are held in check by very minute wasp-like parasites, which lay their eggs in or on the pests and whose larvæ or young feed in the bodies of the scale insects, resulting in the death of the host. It is not uncommon to find the external coverings or shells of the Oyster-shell, Scurfy and Turtle-shell or Lecanium Scales punctured with many holes, showing where these internal parasites have escaped, yet the San José Scale is so very small that the parasites can not find in it enough substance to bring their larvæ to maturity and most of them pass it by without attempting to lay eggs in it.

The chief external parasite or insect which devours the San José Scale is the Lady Beetle. There are a great many beneficial species of this particular family in this country, but they do not appear to have developed a special appetite for the Asiatic foreigner. Professor Marlatt, of the United States Department of Agriculture, at Washington, went to Asia and procured and introduced into this country living specimens of one species of Lady Beetle, upon the efficiency of which high hopes were vainly based by many fruit-growers. Specimens were kept, multiplied, and were disseminated from Washington, D. C., but there is probably not one of these introduced colonies in existence to-day. Certain parasites in this country, and severe weather, combined to kill the beneficial Asiatic Lady Beetles by which fruit-growers were hoping for relief from their most dreaded foe. Our American species of Lady Beetles (or "Lady Birds"), both larvæ and adult, feed upon the San José Scale, especially in its young stage, but they do not hold it in control. There is at present nothing but the spray pump toward which we are justified in looking with certainty to save our property from destruction by the San José Scale.

9. Can it be Controlled?

We are frequently asked if the San José Scale can be exterminated, and we say, "No, but it can be controlled to such an extent that the very finest fruits can be produced upon trees where it has been existing for years, or trees and shrubbery can be kept vigorous and in nice condition, notwithstanding its presence." In making this statement we have in mind the difference between entirely extermi-

nating a pest, or in other words wiping it out of existence as a whole, or merely controlling it or suppressing it to such an extent that it does not appear in destructive numbers. As far as practical purposes are concerned, the control of pests is, in its immediate results, fully as satisfactory as entire extermination. The chief difference lies in the fact that when pests are exterminated, practical measures against them need not be repeated annually nor at regular intervals, but when they are merely controlled, the means of control or check must be applied more or less frequently or regularly, and if it be neglected they will again increase in such numbers as to prove overwhelmingly destructive. This indicates exactly our view of the San José Scale in Pennsylvania. We know where many fruit-growers and farmers have controlled it to such an extent that they no longer fear its ravages in the least, and have yearly produced as fine crops of fruit on trees that were previously badly infested as could be produced on any trees in the country. They are consequently satisfied with controlling the San José Scale alone and are not worrying about the impossibility of extermination. We are certain we would be misleading the public if we should say it is possible to exterminate the San José Scale in this State, even with an annual expenditure of millions of dollars and the employment of hundreds of men. However, it is certainly possible to help our citizens save their property in a satisfactory manner by an annual appropriation not amounting to one per cent. of the loss that would be sustained if such work were not done. It has been exterminated in a few orchards, as far as examinations can reveal, but this has required most careful effort.

The spray pump is an essential feature of every farm and orchard. Its use must become as familiar to the agricultural people as is that of the plow or reaper. In fact, our successful fruit-growers, who have this year sold thousands of dollars worth of fruit, will say at once that the most valuable piece of apparatus which they possess is the best spray pump they have used. It can be employed successfully against nearly all plant diseases, as well as against most insect pests. By its intelligent use such insects as the San José Scale will be effectually and satisfactorily controlled and the infested trees or shrubs will be left in even better condition than though they had not been attacked and sprayed. This is because the Lime-sulphur Wash, which is now generally acknowledged as the best and cheapest remedy, is a fungicide as well as insecticide and also destroys the plant disease germs, which are upon the tree at the time of application. The spray pump as a means of controlling the San José Scale and other insect pests and many plant diseases is as necessary in the hands of the intel

ligent fruit-grower as are lines in the hands of an intelligent driver for controlling and guiding a horse. Let fruit-growers take heed and faithfully follow the directions outlined in this Bulletin, and if they need help write detailed questions to this office and receive the assistance which we are willing to give without charge.

10. Remedies.

A great many different kinds of materials are suggested as remedies for the San José Scale, and many of these have more or less merit. However, to be satisfactory, it should have the following qualities: (a) Effectiveness in killing the scale. (b) Freedom of injury to the trees. (c) Cheapness as to cost and method of application. (d) Ease of preparation and application. These qualifications are mentioned in order of their importance. It must be acknowledged that no insecticide is known that is ideal in each of these four features, as far as can be proven by experiment or actual tests that have already been made. No tree grower is justified in using any newly devised material before it has been fully tested. It may result either in the death of the trees or in failure to kill the scale, either of which would be unprofitable to him. We discuss below some of the common insecticides in regard to the qualifications named above.

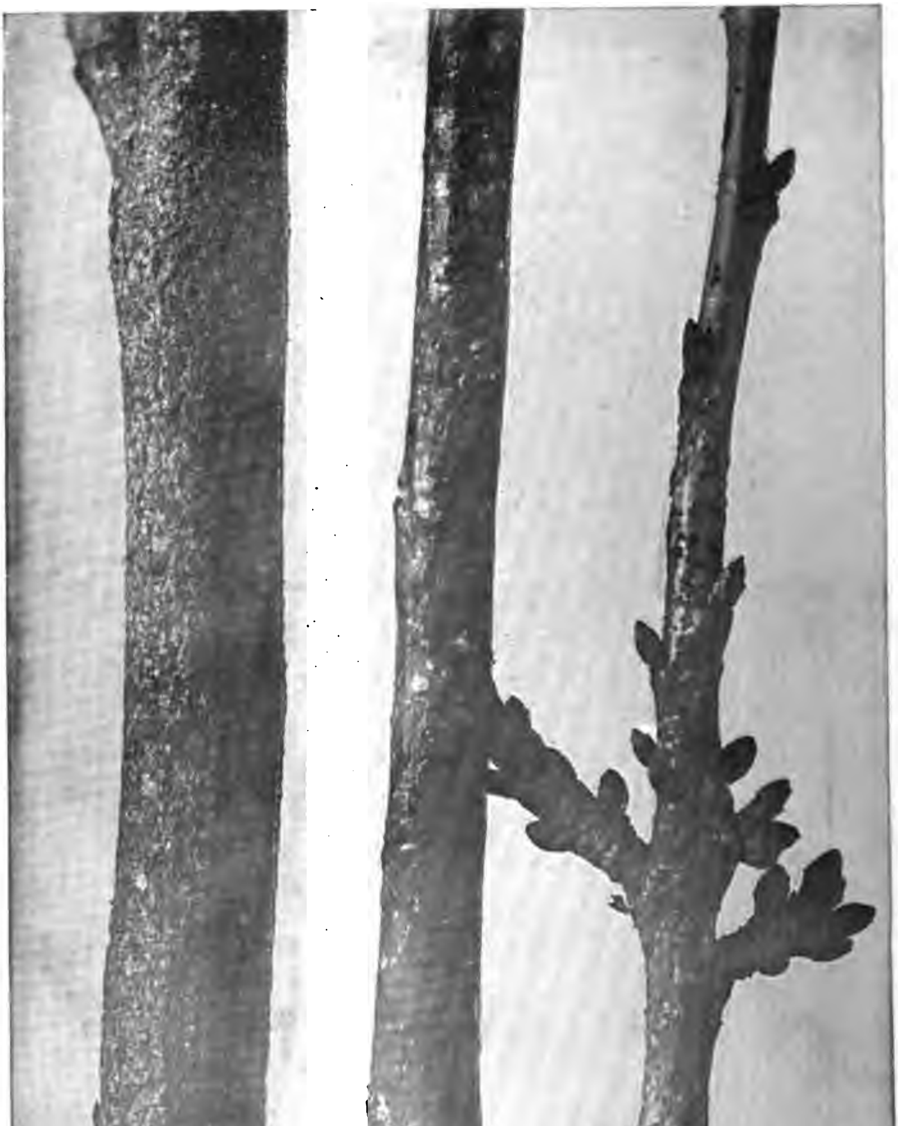
There are only three general methods of successfully treating trees or shrubs infested with San José Scale to destroy the pest without killing the trees. These are as follows: (a) Washing or painting; (b) Fumigating; (c) Spraying. It is to be observed that all of these are processes of contact applications, or remedies that must be applied externally, because the insects are suctorial. Internal applications or poisons, such as Paris green and other arsenites, will have no effect whatever upon the San José Scale, because it does not devour the tissue of the plant upon which the poison may be placed, but lives by sucking, and consequently can not obtain the material intended for it if this be offered as food to be eaten. It should not be necessary for us again to call attention to the fact that Bordeaux Mixture, which is a fungicide only, is not to be used as a remedy against insects, because a fungicide is only a preventive of plant diseases and will not destroy insects. However, we have recently heard of persons who have been spraying with Bordeax Mixture for San José Scale, and, of course, their labor and material were lost.

(a) Washing or Painting.—By washing is meant applying some liquid by hand, using something like a paint brush or whitewash brush. Since the San José Scales cover every particle of the tree to the tips of most twigs, and especially are found beneath buds

Fig. 1.—San José Scale (Aspiriotus perniciosus) on branch of Apple, natural size. On piece of bark at left, above, are magnified specimens. (By Howard, in Circular of Div. of Ent., U. S. Dept. Agr.)

Fig. 2—a, San José Scale on Pear Twig, natural size; b, San José Scale, greatly enlarged, showing the crawling young and the different ages of the insect in the fixed stage. This shows just what can be seen with a good microscope on badly infested trees during the entire summer, after about the tenth of June. (From Howard and Marlatt, in Bull. of Div. of Ent., U. S. Dept. of Agr.)

PLATE XVIII.



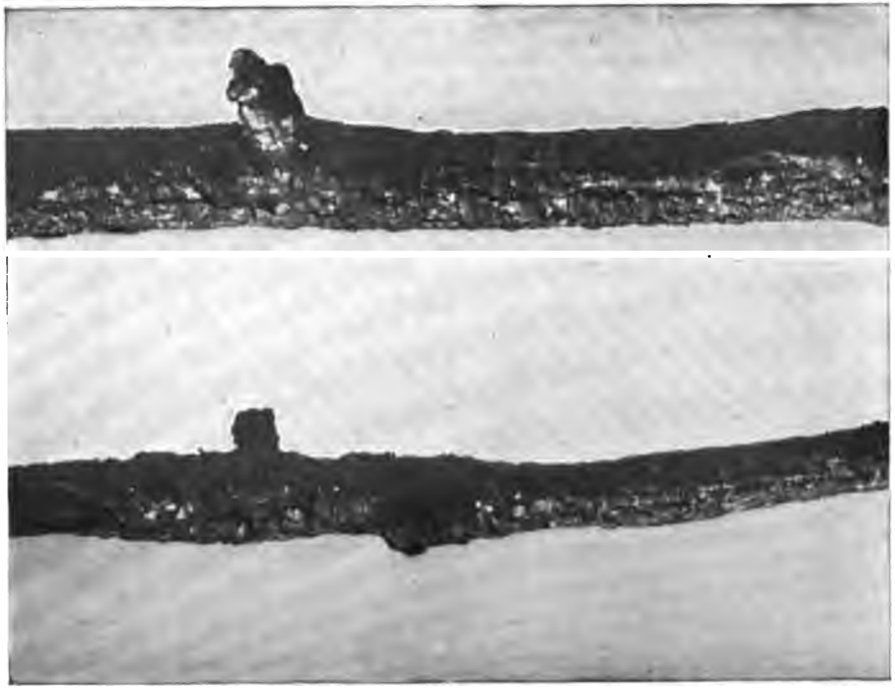
a b c

FRUIT TREE BRANCHES WITH SAN JOSE SCALE.
a. Scale in Winter Resting Stage.
b. Full grown or Adult Females.
c. Scale in Winter Stage, on Sweet Cherry.
All Natural Size.
Photograph of Specimens in the Office of the Economic Zoologist.

PLATE XIX.

Tree Showing Incorrect Methods of Pruning and Spraying. Terminal twigs clipped off last year made bunchy growth later.
Left side well sprayed, with the wind. Right side poorly sprayed against the wind.
Photographed in Orchard near Harrisburg, Pa.

PLATE XX.



Pear and Apple Branches Infested with living San José Scale, but injured by oil. Note the cracked bark just below the side spur in each.
Photographed, natural size, from Specimens collected in Dr. Groff's Orchard at Lewisburg, Pa., by the writer, H. A. S.

PLATE XXI.

and in cracks of bark, it is impossible to apply liquid by the washing process in such a way as to entirely and properly cover an infested tree unless it be one that is very small, or unless the tree be cut back or "dehorned," so that there is nothing to wash but the trunk and stubs of the main branches. Where trees are badly infested pruning is necessary to save them, and this dehorning process is urgently recommended as the best under such circumstances, especially for peach and plum. When the tops are cut off of the trees so that there are no small twigs remaining it is possible to apply a liquid insecticide with brushes and give a thoroughly good coat and obtain satisfactory results. We have reports of orchards in this State where the San José Scale has been almost exterminated by this means. Of course, it means the loss of the fruit for a year, but there will be excellent growth of branches and a good crop of fruit next year if proper care be given. When the bushy growth of several shoots commences around each stub all of these new shoots should be clipped off at once excepting those that are desired to grow to form the new top. This is one method of renewing peach and plum trees and has proven very successful in some places. Since apple and pear do not grow as rapidly as peach and plum there would be more loss of time in producing a new crop by cutting them back severely, but when badly infested this is the only way to save a tree of any kind whether future treatment be by spraying or by washing. One advantage of applying the insecticide with brushes is that there is no great cost of apparatus and as many persons can be started at the work as one may wish with no other expense than the cost of brushes and vessels to carry the liquid. It is a slower process than spraying, but if thoroughly done is sure to give good results. After painting the liquid thoroughly over the portions of the bark, the operator should look over it a second time after it is dry in order to retouch all spots, small as well as large, that may have been missed the first time. In applying insecticides as washes the operator should use just the same material that would be employed in applying it as a spray, excepting in using the boiled lime-sulphur wash, which is undoubtedly the best, less water can be added, thus making the mixture thicker, and it does not need to be strained.

(b) Fumigating.—Theoretically, the best way to kill insects is by subjecting them to the fumes of a deadly gas, but practically this can not be used on orchard trees owing to (1) the very great expense for outfits, (2) the time consumed in the operation, (3) the absolute necessity of an air-tight enclosure to hold the insects and gas during the process of fumigation, (4) the necessity of pure materials rather than adulterated, and (5) the danger of serious effects on trees or careless operators.

The best gas for fumigation is hydrocyanic acid gas made by dropping cyanide of potassium into a solution of sulphuric acid and water, but this is only useful in an air-tight enclosure. It has been tried very extensively by us in fumigating orchards, as well as by the entomologists of other States, such as Maryland, Illinois and California, and in every State in the Union excepting the latter it has been discarded as impracticable for growing trees excepting for those of very small size. Even in California, the only State in which it is yet used practically, we have reports directly from growers to the effect that most of them are using the boiled lime-sulphur wash with satisfactory results, and they are fumigating only the small trees and citrus fruits (orange and lemon.) Nursery stock can be fumigated very easily by packing it in houses erected for the purpose at the time of digging or before shipping. This fumigation of nursery stock when properly done with pure materials results in killing practically all of the insect pests on the trees without any injury to the latter. (Write for our Special Bulletin on Nursery Fumigation.) For insects in buildings we have fumigated experimentally a great many times during the past year with very decided success as the result of each experiment, but fumigation of orchard trees for San José Scale in this State will never become a general practice because the pest can be controlled so much cheaper by the means that our practical orchardists now have at hand and are using, or can be taught to use by our field demonstrators in their practical demonstrations. Fumigation is not "useless," neither is it economical nor practical under conditions in this State for any excepting very small trees.

(c) Spraying.—Spraying is applying a liquid in the form of a very fine mist. To be successful it should be in the form of a genuine spray, looking like steam or mist, rather than a sprinkle, throwing the liquid in drops. For this work a spray pump of some kind is necessary and a nozzle made for the purpose of throwing a fine spray is also essential. One can not spray with a sprinkling nozzle such as is used for sprinkling plants or washing carriages. While this may throw a stream it will not make a spray, and consequently will not have the desired results, because it can not be made to cover all the bark, especially of twigs, and it also wastes much material.

In a spray the liquid is so finely divided that it is in the form of small particles like water-dust or mist and can not be thrown against the wind. For this reason when the wind is blowing it is necessary to spray one side of the tree toward which the spray is carried and leave the opposite side to spray at any time in the future before the buds burst but after the wind has changed to a favorable direction.

It is best to spray the trees from four different directions in order to have the liquid applied entirely to all branches and twigs to the very tips.

a. How to Spray.—In preparing to treat very small trees or bushes it is best to have one man operate the spray pump and another hold the extension rod, carrying the nozzles. Commence to spray the top of the branches and carry the nozzle toward the interior of the tree, following each branch. Then turn the extension rod in such a way that the bend or quarter-turn will make the nozzle point toward the branch in a slightly different direction, and spray from that side. Then turn the spray to the opposite side by using a rod with a bend toward the end or an eighth-turn or quarter-turn attachment. Many branches and the trunk itself can be sprayed from practically three sides merely by turning the extension rod over, without the operator changing his position. After the top has been well sprayed, turn the nozzle upon the trunk and spray that from every side, so that it will be well covered, clear to the ground. No injury comes from enough material being used to run down into the soil, and this may be a decided benefit to peach and plum trees, as it can thus be used to kill the borers, if the gum and dirt are first cleaned away from the base.

For trees with low branches it is necessary to keep the apparatus low enough to pass under the branches or to drive between the trees. Where the branches are low and the trees close together, the tower or elevated platform cannot be used, but where there is room it is quite desirable to construct an elevated platform or tower, and have one operator stand on this. Time is saved by using a pump strong enough to carry two leads of hose. Thus one man operating the pump handle can give pressure or power for two sprayers, each holding an extension rod with two or three nozzles. With such equipment a tree can be sprayed in only a few minutes.

Completely encrusting all parts is necessary when using any of the lime mixtures. To neglect to spray all twigs to the tip with any material, means to leave a great many living insects on them, and thus have the tree reinfested by the descendants of these before the end of the growing season next summer.

b. When to Spray.—The time to spray depends in part upon the number of trees that one may have that need spraying and the amount of apparatus which he may have to do work, or in other words, the time that it would take to complete the job. Our experiments have proven conclusively that the best possible time of the year to spray is in the spring just before the buds burst, especially when using the Lime-sulphur combination, as this stays on the trees best when applied at such time, and has a desirable effect in keep

ing the young scale insects from fixing during the coming summer. However, a person should commence his spraying early enough to be sure to finish it before the leaves are out. Also there is danger of enforced loss of time by intervening bad weather, and the spraying should be begun in time to make due allowance for this. If the orchard be large it is advisable to spray the worst parts in the fall, or better, spray in the fall and again in the spring. If the work be thoroughly done, with a good insecticide, like the boiled lime-sulphur wash, applied in two coats, or retouched by the second spraying, it will not be necessary to spray again for two years.

c. What to Spray.—All trees and shrubs liable to be infested with San José Scale should be sprayed when they are known or supposed to be so attacked. It is not necessary to spray them if they be entirely free from scale. However, in a vicinity where the scale is common it may be taken for granted that all fruit trees are infested, and they should, therefore, be treated to save them before the pests become so numerous upon them. If, for example, there be only a few infested trees or shrubs upon the premises it is quite desirable to spray all that are of varieties attacked with scale listed on a previous page, because although there might be only a few specimens of San José Scale upon each tree at that time, and these could not be found even by a careful search, they would multiply to such an extent within a year as to justify the spraying now to kill them.

It is not at all wise to spray only trees that are visibly infested here and there over an orchard and leave the others untreated. If there be a scattered infestation on the premises there should be a general spraying. However, it is not necessary to spray maple, elm, walnut, hickory, ash and other some forest and shade trees. Look over the two lists given in preceding pages, and if your ornamental trees and shrubbery be not named in those lists, it is not necessary to spray them, even though they be standing near other trees having San José Scale. Of course, old fruit trees are liable to be infested, as well as young, and when this is the case they should be sprayed soon, because after such trees are badly injured they are not liable to regain their vigor and usefulness.

d. With What to Spray.—Materials or Insecticides.

The three general groups of insecticides which can be used successfully for control of the San José Scale are as follows:

I. The Lime-sulphur Compounds. II. Oils in some form. III. Soap Solutions. If used in proper proportion and in the correct manner any one of these can be made to give good results.

The kind of material to use depends in part upon conditions, such as the kind of trees or shrubs to be treated, their size, age, and condition of insect injury. Where a person has but a few trees in a

lot or upon a lawn, he can afford to give them much more time and care individually than though he had to treat several thousand trees in an extensive orchard, but at the same time he cannot afford the large or expensive apparatus necessary for doing thorough spraying upon large trees, neither can he always afford the time and trouble to make and apply the best known remedy—the boiled Lime-sulphur Wash, if he can hire his spraying done or do it for himself by using a good commercial insecticide.

I. THE LIME-AND-SULPHUR COMPOUNDS.

The best and cheapest materials for controlling the San José Scale, and also acting as fungicides to rid the trees of certain diseases which would otherwise attack them in the spring and summer, are the Lime-sulphur compounds made by heating Lime and Sulphur together until they form a new chemical substance, which is much different from either and has a greater chemical action than either alone. The best of these, because the cheapest that is effective, is the boiled Lime-sulphur Wash. There are a great many variations of the Lime and Sulphur Formulæ, but these variations are not important. As a general rule, it is better to use a few pounds more Lime than Sulphur just to meet the condition that the Lime is not pure while the Sulphur is so. This makes up for the probable amount of impurity in the Lime. However, it is not necessary nor desirable to use twice as much Lime as Sulphur, as it makes an additional amount of the substance that clogs the nozzle, without increased benefits.

(a) The Lime-Sulphur Wash.

The most common formula for this wash is as follows:

Lime, 22 lbs.
Flowers of Sulphur, 17lbs.
Water, 50 gals.

Put the Lime and Sulphur together, and use enough water to boil. Boil one hour, strain, and add enough water to make the fifty gallons required in the formula.

In regard to efficiency in killing the scale, beneficial results on trees, ease of obtaining material, and cheapness of original cost, there is no insecticide that can equal the boiled Lime-sulphur Wash. The only thing that can be said against it is the trouble in making and applying it, which is not great when the operator knows how to do it.

It is slightly troublesome to make but it has great advantages. Among these are the following: The exact proportions are not necessary. If a person should get a little more or a little less of any one ingredient he does not injure the efficiency of the Wash in killing the scale, nor will he thereby inflict any injury upon his trees. There is no possible danger of applying too much of this material to any kind of tree, as in using the oils which have been unduly advertised and applied with such disastrous results. No special apparatus of any unusual make is necessary in either making or applying this material. It can be applied at any time of year when the trees are not in leaf. By its white coating the operator can readily see what spots may have been missed and can thus be sure of the chance to retouch them, and the person who engages another to spray his trees can see for himself if the work has been thoroughly and properly done. (This is a very important point.) It is a fungicide as well as an insecticide and cleans up many of the disease germs, such as those causing leaf curl, ripe rot, leaf spots, rusts, smuts, mildews, bitter rot, apple scab, pear crack, black rot, and other diseases of leaves or fruits. It is not injurious in any proportion nor any amount upon any kind of tree even of the most delicate varieties. It is very cheaply made, costing but a little over a cent per gallon when dilute and ready to apply to the trees. Of no other known insecticide can the above statements truly be made. We unhesitatingly recommend it as absolutely the best, cheapest and safest remedy for controlling the San José Scale, and the slight trouble in making it is reduced to insignificance if the operator be provided with apparatus even no more complicated than two or three iron kettles set into a rough furnace or protected by stone walls along each side to retain the heat and keep the wind from blowing the flames away.

In general, the method of getting the lime and sulphur together before boiling is not at all essential; neither is the kind of vessel in which it is to be boiled. We have had equally good results with common iron kettles standing or suspended over open fires, common galvanized iron wash tubs on two walls of stone, box-shaped vats of sheet iron built for the purpose, furnaces constructed for boiling, and even kettles and boilers upon kitchen stoves. However, a copper kettle should not be used, as the chemicals will readily combine with the copper and ruin the vessel. We generally put the lime into the vessel in which it is to boil, sprinkle part (perhaps half) of the sulphur over it, pour on enough hot water to start it to slaking well but not to drown it, add the remainder of the sulphur and more water (hot or cold) in a short time, stir the masses well together, add enough water, hot or cold, to make it thin enough to boil well, stir to the bottom occasionally, bring it to the boiling

point and boil for at least three-quarters of an hour after it reaches this point. Many persons will say that they can get the red color by less boiling, but while this is true we do not think they can get the entire combination necessary for the best results within less than three-quarters of an hour from the time boiling commences. After boiling use cold water to dilute to the full amount required in the formula.

If the mixture is to stand for some time crystallization can be prevented by diluting it while it is yet warm. In this event, however, it should be again placed over the fire and heated before being put in the spray tank for the purpose of making it thinner and putting it through the nozzles in the best manner. If it be not diluted before cooling it can be prepared when wanted by diluting with hot water or skimming out the crystals and boiling them until dissolved and using this solution for diluting.

Where such material is needed it is advisable either to construct special tanks or vats for boiling on an extensive scale or to use live steam from an engine, conveyed by means of a pipe extending to near the bottom of the barrel of liquid to be boiled. By this means one can boil it in wooden tanks or barrels, and it is even possible by means of live steam to boil it in the tank from which it is to be sprayed, but in this case a basket-shaped, fine wire strainer should be arranged around the entrance to the spray pump. Often steam may be obtained by means of a threshing engine or stationary steam engine, especially such as a small engine at a creamery, and many persons may find it advisable to arrange to have their material boiled in this way. Such boiling has the advantage of doing away with the expense and trouble of kettles, and the work of stirring occasionally while boiling to keep from sticking to the bottom.

Where steam is to be had, as from a house heated by furnace steam, greenhouse, creamery, threshing, or other engine, it is an excellent plan to extend the horizontal pipe over a row of barrels and into each of these extend a vertical pipe almost to the bottom and boil the material by live steam. This, of course, can be boiled in barrels and does not necessitate stirring. It should boil fully one hour from the time real boiling commences.

The results with the lime and sulphur washes have shown that they are fungicides or preventives of such plant diseases as leaf curl of peach, brown rot of peach and plum, leaf spot, rusts, smuts, bitter rot of fruits, apple scab, pear leaf blister, etc. For this reason some of our best fruit growers say they will spray with this wash every spring shortly before their buds burst, even though they may not have much San José Scale.

It does not make any difference how the materials are added to the water before boiling, but it is best to slake the lime with enough water to slake it, but not drown it, and stir the sulphur into a paste, with enough water to make it mushy and add this at any time and add enough water to let it boil, stirring occasionally to keep it from burning the bottom. The boiling is absolutely necessary, as good results can not possibly come without it. By means of the heat a new mixture is made, that is not sulphur, nor is it lime, nor is it a mixture of the two, but it is composed of several compounds of lime and sulphur, and they differ as much from the original material as water differs from its two elementary components, hydrogen and oxygen. The new compounds are very caustic and are liable gradually to eat through the skin of the hands of careless operators or even to take the hair off horses if they be not properly blanketed. By proper straining to prevent clogging the nozzles, covering the hands with vaseline or melted tallow, wearing gloves soaked in melted tallow, and a large handkerchief or cloth around the neck, spraying only with the wind, and keeping the horses blanketed and out of the spray, this material can be applied with perfect safety and without much trouble or offense to operators. It is no worse in this regard than is crude petroleum or whale oil soap, and does not stink as badly as either.

We are occasionally asked if a "Self-boiled" Lime and Sulphur, made by merely the heat of the lime, will give satisfactory results. It certainly will not, any more than will beans that have been boiled only five minutes be fit for human food. After boiling it is not necessary to dilute with hot water, as cold water will do just as well for diluting purposes. It is not the heat that kills the scales, yet we apply it warm (not boiling hot) because it runs better through the nozzles and makes a better spray while warm than when cold and thick. It is better to keep it warm from the time it is made until it is used to prevent the formation of bothersome crystals, but if this be impossible it should at least be diluted before permitting it to stand and get cold. The best way is to not make more in one day than is to be used that day, although we know where it has been made and shipped successfully for use at another place. In our experiments to determine how long it can be kept and at the same time be efficient, we have learned that it can be kept for months and heated and used with good results.

The Salt.—The salt is not necessary as an ingredient in this mixture, but it may increase the adhering power or makes it stick better to the bark, and it makes the solution more condensed and raises the temperature at which boiling takes place, and consequently may give a higher heat and more perfect union of the lime and sulphur

However, it is more liable to rust the apparatus and wear the nozzle, and also it is more liable to be injurious to the sprayed trees, especially tender peach twigs in the fall. We have never seen any evil results in regard to injury of treated trees or shrubs from spraying with the Lime-sulphur-salt Wash, excepting when the Lime-sulphur-salt combination was used and sprayed on tender peach twigs in the fall. In a few orchards the smaller branches were killed by this treatment and in one orchard where we sprayed both in the fall and in spring, the latter spraying did not result in any injury to the trees while the effects of fall spraying were quite serious.

Our experiments have proven conclusively that the scale is killed quite as certainly without the Salt being added to the boiled mixture as when it is used. Its use slightly increases the expense of the material and the trouble in preparing it, and consequently we advocate omitting it entirely. In this we are supported by other entomologists and zoologists from various Experiment Stations of America. (See the Summary from Prof. Smith's Georgia publication given in December Bulletin, 1906.)

The Sulphur.—It is essential for the sulphur to be powdered, as we have tried the roll or stick sulphur (brimstone) without satisfactory results. Flour of sulphur is that which has been melted into cakes and then ground. Although it is a dust it is not as finely divided as the flowers of sulphur, which is deposited by sublimation, or heating and driving against a cool surface, just as soot or lamp black is deposited upon the lamp chimney by smoke. This is yet more finely divided than the flour of sulphur, and for this reason we recommend the flowers, as the union with the lime will take place sooner and perhaps more completely, although by a little longer boiling the flour can certainly be made to do as well. From the wholesale dealers the flowers of sulphur cost but twenty cents per hundred pounds more than the flour of sulphur, and this difference of expense should not be enough to justify using that form which is liable to give less satisfactory results.

Flour of Sulphur can be purchased at about $2.40 per hundred pounds, in barrel lots, loaded on board the cars, or the Flowers at about $2.60 per hundred pounds, for barrel lots, also F. O. B., of such dealers as Powers-Weightman-Rosengarten, Philadelphia, Pa., The Thomsen Chemical Company, Baltimore, Md., and the Bergen Point Sulphur Works, Burling Slip, New York City. If there be other convenient manufacturers selling Sulphur wholesale from central points, especially anywhere in the State of Pennsylvania, we shall be glad to be informed of that fact and make proper announcement for the sake of persons who may wish to know where to buy from dealers near their homes, and consequently save freight. It should be remembered that the Flour of Sulphur is sold either in

sacks (100 pounds) or in barrels, with not less than three hundred pounds in a barrel, while the Flowers of Sulphur, which is the sublimated or more finely divided condition, is sold by wholesale only in barrels, but these barrels weight only one hundred and fifty pounds. In boiling the Lime-sulphur Wash there is practically no difference in regard to the form of powdered Sulphur used, for both forms are pure Sulphur; but in making the Self-boiled Wash or Caustic Soda Wash, depending upon hot water and chemical action for the combination of the Lime and Sulphur, it is better to have the more finely divided form, known as Flowers of Sulphur, because it is necessary to have every possible factor in favor of making the most perfect union of the chemicals with very little heat.

To mix the Sulphur or add it to the mixture the best method is to put it in a vessel like an ordinary kettle or water bucket, and add enough water to make it possible to stir it into a paste or mush. Then add this wet paste of Sulphur to the mixture, and it will enter the water readily and not stay on top in little dry yellow lumps, as it does when the dry Sulphur is added to any mixture containing water. Sulphur can be kept many years without losing its beneficial qualities, and as it is useful in destroying other pests, especially parasites on fowls and live stock, it is well to buy it by the barrel and keep it on hand.

The Lime.—The lime should be the best possible quality of calcium to be obtained, and a grade which is as free as possible from sand or sediment. Where there is much sediment this can be determined by slaking some of the lime, and adding enough water to make a milky solution, stirring, pouring off the milk of lime and examining the deposit at the bottom. If there be much sediment it will be better to slake the lime and make a milk of lime before boiling, and strain it before putting it into the vat or kettle in which it is to boil. At all times the mixture should be strained through a fine wire netting when it is poured into the tank from which it is to be sprayed. It is important that the lime used should be oxide of calcium or true lime instead of oxide of magnesium or magnesium lime.

Many persons have noticed that sometimes in boiling the Lime and Sulphur together to make the Lime-sulphur Wash the color becomes brick red, or more exactly the color of cooked tomatoes and remains so, while at other times it first becomes dark red, but by a little further boiling turns to a dark olive green color. There is evidently a cause for this difference, and this is no doubt to be found in the difference in the chemical composition of the Lime. It has been and is yet the opinion of most persons that the red mixture is to be obtained only with Calcium Lime or Calcium Oxide,

while the olive green color comes from the use of Magnesian Lime or Oxide of Magnesium. We know that the latter is more mild in its action, and for this reason it may not have such decidedly killing effect upon the scale. We have previously directed operators to use the Calcium Lime, as we wish to be sure of best results. We have not been able to have chemical analyses made to confirm our suspicions in this regard, but we are now gratified to see that Prof. Smith, of Georgia, in a recent Bulletin on the San José Scale, endorses our view in regard to the Calcium Lime being more efficient than the Magnesia. (See Summary from the Georgia Bulletin published in the last December Bulletin.) It is no doubt owing to the difference in the character of the Lime that the discussion arises from persons in different parts of the country as to how long the material should be boiled, as far as color becomes the criterion. Some say the length of time for boiling is until it becomes olive green, and others say that they find it impossible to do this, as it remains dark red. It certainly is not necessary to boil it longer than one hour of actual boiling, whether the color be green or red, but it is important to not stop the boiling as long as any light yellow sulphur can be stirred up from the bottom. Boil until this is all gone. Stir to the bottom occasionally, but it need not be stirred all the time.

To Keep Lime Fresh.—It is often necessary to buy quite a quantity of lime at one time and keep it in stock ready for use in the future. If kept dry or exposed to the air it will become air-slaked or undergoes a chemical change which results in a form of lime entirely different from that which is produced from slaking with water. The air-slaked lime is not suitable for making the lime-sulphur washes, and this may be one reason why persons who have used it have not had better results with the lime-sulphur-salt wash. Quick lime or fresh lime is always required, but this can be slaked when received and kept in a barrel or other vessel, under water, in the form of paste or putty. Keep it covered with an inch or more of water so that it will be wet all the time, and it is ready for use whenever needed. Dip out the amount required in any formula, making allowance for the added weight of the water in which it is mixed. This means three times as much of this putty of lime should be used as is required in a formula calling for unslaked lime.

The Strainer.—Nearly all firms making spraying apparatus now make and sell strainers especially adapted to strain such materials as the Lime-sulphur Wash. However, most of them are so constructed that they readily clog and give a great deal of trouble. There is no one feature of spraying with the Lime-sulphur Wash that is more disagreeable or annoying than the clogging of the

nozzles. All who have sprayed with the Lime-sulphur Mixture will emphatically agree with us in this statement. Yet we have been able to spray for one-half day at a time with material made according to the regular formula, without one clogged nozzle during that time. This is accomplished by cleaning the kettles, barrels and spray tanks well, especially the interior of the tank and hose, so

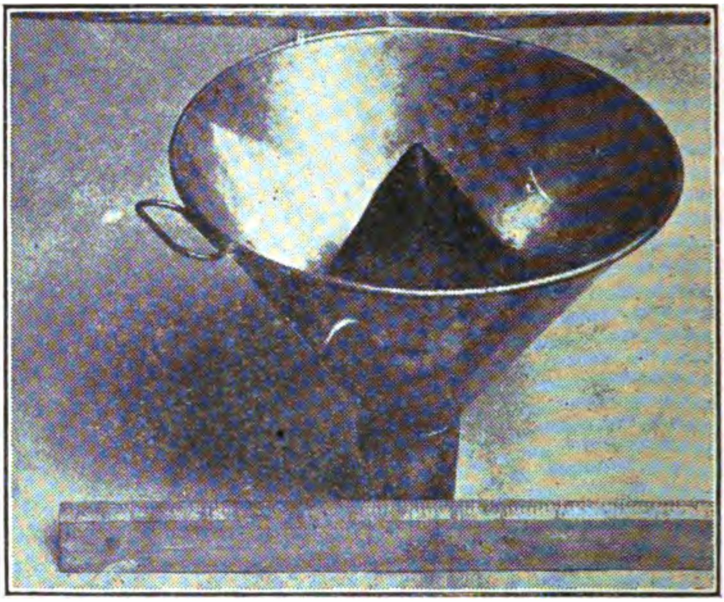


Fig. 24. Conical Strainer for straining Lime-Sulfur wash easily. Made under the direction of the State Zoologist and photographed in his office.

that no dirt will be in it before the mixture is added. Then strain the mixture properly and afterward keep the tank covered so that pieces of bark and other small particles can not fall into it from the trees under which it is drawn, and later find their way into the nozzles.

In straining, a piece of wire netting or cloth should be used, which has the wires at least as close together or as many as twenty-six to the inch. Window screening will not do for this. Gunnysack or Coffee Sack is quite poor material to use for straining. In fact, no cloth is suitable for this purpose. The lint or fibres are liable to be carried into the spray tank and readily clog the nozzles. In straining with cloth some threads are liable to be pushed aside and larger particles than are desired will crowd through them.

The best commercial or ready-made strainer that we have seen is one that has a large flat sheet of wire soldered across at an angle, in such a way that one side is much higher than the other. The

liquid strains through this fairly well. The poorest metal strainer that can possibly be used is the one that is merely a sheet of wire placed flat across a funnel, as most strainers are, and the best that we have ever used and which we are now placing in the hands of our demonstrators is made by our tinner, and consists of a cone of fine brass wire netting placed upright in a funnel in such a way that the base of the cone comes down inside the funnel, toward its lower part, and the apex or point of the cone stands up inside the middle of the funnel and is strengthened or supported by a few heavier wires or a very coarse wire netting (one-fourth inch mesh) fastened under it from the under or inner side, before the fine wire is put into place. Through this conical strainer the Lime-sulphur Wash runs almost as freely as water, and at the same time the straining is done very thoroughly. The sediment collects around the upper base of the cone in such a way that it can be thrown out or put back into the kettle for further boiling as may be desired. As far as we know this device is our own origin, and not being patented is offered to the public as a great convenience in this work.

(b) The Lime-Sulphur-Soda Wash.

Fresh lime, 22 pounds.
Sulphur, 17 pounds.
Caustic soda, washing soda, or lye, 4 or 5 pounds.
Water, 50 gallons.

This is recommended as a good lime-sulphur wash that need not be boiled if made with great care. It can be made in a barrel, tub or vat without the addition of any other heat than that which is produced by putting the materials together in the proper way. This is done by slaking the lime with hot water and adding about one-third of the sulphur to the lime before it commences to slake. Keep the barrel covered with wet blankets or carpet. Before it has finished slaking add another third of sulphur with a little more hot water, and by the time it is done add the remainder of the sulphur, add more boiling water and stir the mixture together; dissolve the caustic soda or lye in hot water and pour about one-third of this solution into the barrel and cover it quickly with blankets. A great deal of steam and gas will escape, but as much heat as possible should be held in. Let it stand ten minutes, stir it well and add the second third of the caustic soda or lye dissolved in hot water, cover it again immediately, and let it stand ten minutes more. Now stir it again, add the remainder of the caustic soda dissolved in hot water, cover it quickly and let it stand again ten minutes, when it is ready to add enough water to make the entire amount 50 gallons, and apply either as a spray or wash, just as in using any other lime-sulphur mixture.

We know where this has been made and used with emphatic success, and for comparatively few trees, where one is not equipped to make the boiled lime-sulphur-salt wash, this can be made without the necessity of boiling, but at slightly increased expense. It is as satisfactory as any of the other washes of its general class, both as an insecticide and as a fungicide. It can be made with water heated in a wash boiler on a kitchen stove.

Caustic potash, or washing soda, or even concentrated lye, such as is sold in the stores for making soap, can be substituted successfully for the caustic soda, and it is probable that strong lye made from wood ashes can be used with equal success in place of soda. Unless made with great care, in order to procure and use all the heat possible, it will not be as effectual as the boiled wash.

(c) Livers of Sulphur, or Potassium Sulphide.

Potassium sulphide or livers of sulphur, 1 pound.

Fresh lime, 1 pound.

Warm water, 2 gallons.

Mix these together and apply as a spray or as a wash with a brush when the trees are dormant, or paint this mixture on the bark at any time. This is to be used in exactly the same manner as the other lime-sulphur washes, and is both an insecticide and a fungicide. It can be made in any kind of vessel and needs no other heat than that in the warm water. It is the most easily made insecticide that can be recommended for the San José Scale, and is therefore especially useful where one may have but a few choice trees which he may wish to preserve without the trouble of making either of the preceding mixtures. While it is the most easily made substitute for the boiled lime-sulphur-salt wash, it is at the same time the most expensive of this series of insecticides, and, owing to the cost of the potassium sulphide, it cannot be used in large orchards or on many trees.

II. OILS FOR THE SAN JOSE SCALE.

There are several forms of oil that can be used with more or less success in killing San José Scale, but these must be used with care and with a full knowledge of the possible evil results of improper methods. One great value of the lime-sulphur-salt wash is that an inexperienced person cannot apply enough material prepared by any of the foregoing formulæ to injure the plant, while many trees have been killed by the application of too much oil or a mixture containing too high percentage of oil, or by oil of an improper grade. Trees vary in their liability to injury by such substances. While pear trees can often stand a spraying of pure petroleum or even a light spraying of pure kerosene, oil should not be applied stronger than 50 per cent. to apple, nor stronger than 40 per cent. to plum.

nor more than 25 per cent. to peach trees. In order to reduce the percentage it is necessary to apply the oil either in the form of a mixture, which is to be mixed by a mechanical device at the time of spraying, or in the form of an emulsion, in which the particles of oil are kept suspended in the mass of the diluting mixture, which is generally water.

No oil should be applied on trees until it runs down in streams and branches should never be soaked with it. It is particularly liable to injure the larger branches of trees by being absorbed by the thick bark, causing the death of this covering. We have seen many fine trees badly injured by the excess of oil that penetrated the thick bark of the branches. It is singular that this substance will not injure the thin bark of the trees as readily as the thick spongy bark, which seems to hold it longer.

(d) **Crude Petroleum.** Crude petroleum is a first class remedy for the San José Scale upon pear trees, but care should be taken to avoid soaking the thick bark with it. If this be used the operator should purchase only that which has a specific gravity of 43 degrees, Baume, or higher. Undilute crude petroleum cannot be safely used on apple and the other fruit trees, except pear. Several persons have killed plum trees with this material. (See Injured Branches, Plate XXI.) A fruit grower in Jamesburg, N. J., recently told the writer that he had killed all his plum trees and 500 three-year-old pear trees by spraying them with crude petroleum. On the whole it is not as good an insecticide as the lime-sulphur-salt wash and does not have the added advantage of being also a fungicide.

In spraying with oils there is less danger of injury if the work be done on a bright sunshiny, slightly windy day. so that the evaporation will be as rapid as possible. The heavy crude petroleum, which contains paraffin, with but little vaseline or asphaltum base, is more likely to kill the scale without injury to the tree than the lighter varieties of this form of oil. The oils with vaseline or asphaltum base are especially injurious.

Oil Emulsions.

A good way to apply oil at a certain desired percentage of dilution is to make it into an emulsion. By this means one does not need an especially made spray pump, and with care he can obtain exactly the percentage of oil which he desires.

Make a stock of kerosene emulsion as follows:

(e) **Kerosene-Soap-Emulsion.** Hard soap, or whale oil soap, one half pound; water, 1 gallon; kerosene, 2 gallons. Shave the soap fine in boiling water and thus dissolve it, remove this soap solution from the stove and add it to the kerosene while the water is boiling

hot and churn it around through the spray pump a few minutes until it turns to a uniform creamy mass. If this be fully and properly agitated it can be kept for any length of time without the oil separating. For use add whatever amount is needed of this 66 per cent. mixture to enough warm water to give it the desired dilution. It should be remembered that the stock emulsion is only 66 per cent. kerosene, or two parts oil and one part water, and to use equal parts of this with water would not give a 50 per cent. solution, but one of only 33 per cent. oil.

(f) Kerosene-Milk Emulsion. In making small quantities of kerosene emulsion it can be made with sour milk and kerosene as follows: Sour milk, 1 gallon; kerosene, 2 gallons; churned through the spray and used in the same way as the soap emulsion. Where the lime-sulphur compounds cannot be made, this material will aid in holding the San José Scale in check, and upon apple-trees especially some persons claim to have obtained better results than with any other material. Refined kerosene or common lamp oil is generally used in making emulsions, but crude petroleum can be used for this if desired. However, it often costs as much as does the kerosene and in a good emulsion of proper percentage it is no better.

(g) Oil Mixtures.

Either crude petroleum or refined kerosene can be applied in the form of a mixture by using a spray pump such as the Kero-Water-Sprayer, the instrument devised for making a mechanical mixture of the oil at the time it is applied. The great danger with such mixtures is the variation in percentage, and the consequent liability to injure trees by occasionally applying stronger than is intended. Thirty five per cent. mixture of kerosene or crude petroleum will kill San José Scale, and can be used upon all kinds of trees excepting peach, and the delicate varieties of plums. Upon peach and plum, especially, nothing is so effective or satisfactory as the lime-sulphur wash. (To be concluded in November issue.)

Note.—The Bulletin on Turtles and Lizards of Pennsylvania, in course of preparation, has been held for the December issue. H. A. Surface.

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THE

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DIVISION OF ZOOLOGY

OF THE

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SUBJECT: The Scale Insects.

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H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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SUB-ORDER B. HOMOPTERA. THE CICADAS, PLANT LICE, SCALE INSECTS, ETC.

Family IX. Coccidæ. The Scale Insects, Bark Lice and Mealy Bugs.

In our Monthly Bulletin for January, 1906, Volume III., No. 9, page 274, we commenced "A General Systematic Study of Insects—Part I." In that Bulletin was published a brief discussion of the Arthropoda or "Joint-footed" animals, and a fuller treatise of Hexapods or True Insects, and the relationships of the three other classes composing the sub-kingdom. We there published concerning the chief of the lower Orders of Insects. The last was concluded on page 292 of Volume III. This subject was resumed in Volume IV., No. 2 for June, 1906, page 48, completing the study of the Sub-order Heteròptera, or True Bugs, on page 72. It was further resumed on page 69 of Volume V for July, 1907, discussing the various Families of the Sub-order Homoptera, excepting the Coccidæ or Scale Insects, and concluded on page 86 of this Volume. We take this occasion to offer the correction that the egg punctures shown in Fig. a, Plate IX., of the July Bulletin are not made by the Buffalo Tree-hopper, but by another species of the same genus known as the Cow Tree-hopper, scientific name, *Ceresa taurina*.

It now remains for us to discuss the Family Coccidæ or Scale Insects and thus conclude the study of Homoptera, or the second Sub-order of the large Family of Hemiptera, generally and properly called "The Bugs."

To the Family of Coccidæ belong those insects known as Mealy Bugs, and also the Scale Insects or Scale Bugs, sometimes called Bark Lice. In the adult stages especially these creatures do not resemble those forms of life that we are accustomed to call Insects, and it is difficult for the uninitiated to observe one of them and realize that it is really a living insect. They are distinguished by their fixed condition or "sedentary habits," the structural mouth parts, and the waxy or scale-like covering or the gall-like form of the body of the adult.

A peculiarity of the Coccidæ is the remarkable fact that the males differ from all others previously discussed in these Bulletins by undergoing complete metamorphosis, or in other words transforming from the larva to the adult through a third or chrysalid stage, and appearing in the adult form as winged creatures, entirely unlike their former selves or the females of their own species. These adult male Scale Insects have only a single pair of wings and are extremely delicate in appearance and texture. They are further remarkable for the fact that they have no beak or mouth parts for partaking of food and do not eat or feed when in this mature state. A second pair of eyes appears in the place of the mouth parts. The only winged forms of Scale Insects are the males, as the females never develop wings, and are active only in a very few species.

The scale insects are truly listed as among our most destructive pests, for the reasons (1) that they are so small as to escape observation until after they have seriously affected the plants on which they are found; (2) they live by sucking juices rather than eating away the tissue of the plant; and hence are not conspicuous in their methods of attack; (3) they multiply so rapidly that they may cover a plant before their presence is suspected; (4) they inject a poisonous saliva or juice into the plant by which it is severely injured before sucking out its sap, just as the mosquito injures us mostly by the injection of its venomous saliva; (5) some of them attack a large variety of plants, and thus they spread more rapidly and certainly than though conveyed to but a few species of the vegetable kingdom; (6) they are very easily carried long distances while living, being disseminated upon plants either in growing or dormant condition. Wherever plants are carried by mankind, there their pests, in the form of Scale Insects, may be expected.

Notwithstanding the serious destruction by the insects of this Family, it must be recognized that some are also of economic value. For example, cochineal, which is a red dye commonly used for cakes and candies, is nothing more than the dried bodies of insects of this Family, collected by scraping them from the cactus plants of Mexico. Shellac, a common form of varnish, is prepared from the shells or covering of Scale Insects living on tropical trees, and China Wax is also a product of Scale Insects of Asia. Considerable employment is given to persons engaged in the collection and preparation of such material.

The Coccids multiply either by bearing living young, as does the San José Scale, or by laying eggs as do the Oyster-shell Scale, Scurfy Scale and others. With all species the young move freely and may crawl around over their food plant for a period of time,

varying from a few hours to a few days, and may possibly reach a distance of several feet from the parent. It is during this young and free-moving stage only that they are carried from tree to tree or from plant to plant, excepting when they are fixed on wood that is to be used for further growth, as on young trees, cuttings, buds or scions.

All kinds of young Scale Insects are carried upon the feet of birds of many kinds that alight in the trees when the pests are young and moving. They are especially liable to be transported by the English Sparrow, because these birds live almost continuously in flocks, are found abundantly near the abode of man, alight in bushes and small trees, and fly only short distances in their rather heavy flight. The fact that such insects are carried to a great extent upon the feet of birds is proven by the common occurrence of these pests on the branches of trees near birds' nests. The American Robin has been unjustly condemned for its instrumentality in carrying Scale Insects, as there would be just about as many transported by other means, even if these pests should not occasionally find their way to the feet of any Robins perched on infested limbs. Young Scale Insects are also blown through the air, as are fine grains of sand, as proven by our commonly finding them on plants beyond infested trees, in the direction they would be carried by the prevailing wind. They are also carried from plant to plant upon leaves or twigs that would be broken off the parent tree and thrown or blown away, as in a storm.

The larger insects, such as June Bugs or May Beetles, Grasshoppers, Butterflies, Katydids and Bees often unconsciously transport young Scale Insects which crawl upon them, when alighting on their trees. Quite a collection of insects has been made transporting upon their bodies, smaller individuals, which have actually been found to be young Scale Insects. This proves that such a statement is not the assertion of mere theory.

Another means of conveyance of these pests from tree to tree is by squirrels, cats or other animals that would run up the tree or over the branches when the insects are in their young and free-moving state, and which cling to the fur or feet of the animals. Such pests are also disseminated by crawling from branch to branch, where the branches of different trees intertwine, and are also liable to fall upon the backs of horses or other domesticated animals beneath the tree, and thus be carried from one part of the orchard to another. It has also been proven that they may be carried upon the clothing, hands or tools of workmen engaged around the tree during the period when the young are moving and in a condition to be conveyed from one tree to another. It is of considerable

practical importance to bear in mind that Scale Insects are carried from tree to tree or from plant to plant only when they are upon wood which is to grow again, or when they are young and free-moving. In other words the adults or fixed Scale Insects can not possibly be scraped loose from the bark of the tree and fix themselves on any other tree and live. This shows that the precaution of burning trimmings from infested trees is not so imperative with Scale Insects as with trees infected with diseases, such as Pear Blight and Plum Knot in which the germs would remain virulent in the branches if dropped on the ground and permitted to remain there. In plain words, the trimmings of diseased or infected trees should be burned at once and the knife sterilized occasionally to prevent carrying the infection, but the case is different with trees infested with Scale insects. This is not infection but infestation. Infested trees are those attacked by insects. Branches infested with those Scale Insects which do not lay eggs do not necessarily need to be burned at the time of trimming, as the pests will die soon if the branches are cut off and their supply of food is no longer available.

In this connection it must be said that Scale Insects are not carried alive upon ripe fruit nor spread from such fruit to trees or plants where they would live. Such a thing is impossible, as we have demonstrated with careful experiments running through several seasons.

When a Scale Insect fixes upon clean fruit it is doomed, as it can never free itself again. Thus the laws of Oregon and Germany, demanding the destruction of infested fruits, are unjust both to shippers and consumers, and are based upon ignorance of the facts of the case.

When Coccids are first hatched or born they are in their most delicate condition and then most easily injured or killed by insecticides. Since they are sucking insects, and do not eat or chew the tissue of the plant, they must be killed only by contact insecticides. Internal poisons, such as Paris Green, would not affect them, because these do not kill insects that do not swallow the parts of the plant to which they are applied. The Bordeaux Mixture is not an insecticide but a fungicide, and is consequently not to be recommended for insects of any kind. For young Coccids of all species the contact insecticides will be found very useful and can be used so mild or dilute that the host plant will not be injured by the application of the same. While the insects are young and in their free-moving stage they are not yet covered by their waxy water-proof protecting coats, and are consequently to be killed by such dilute substances as Whale Oil Soap, one pound in six gallons of water,

or Soft Soap, one pound in four gallons of water, or Ivory or Common Laundry Soap, one pound dissolved in three or four gallons of water, or Kerosene Emulsion, about eight per cent. or Tobacco Decoction, one pound in two gallons of water, or more or less mild fumigation with Tobacco Smoke, Sulphur Fumes, Hydrocyanic Acid Gas or Carbon Bisulfid. While the insects are young and delicate these substances can be used in such mild proportions that the growing plants upon which they occur will not be injured, but after the pests become mature they are protected by their waxy woolly or scale-like waterproof covering, are not to be killed by any contact insecticide that will not at the same time seriously injure or destroy the green leaves of the plants upon which they occur. This explains why young Scale Insects and Plant Lice can be killed by the application of mild insecticides during the summer time without injury to the plant, but for the adult or fixed Scale Insects the sprayer must necessarily wait until the dormant period of the plants, and then treat the pests by spraying or washing thoroughly with some strong contact insecticide that will kill it but not injure the tree or plant upon which it is to be found.

This also explains why it is very important to watch most closely and carefully those species of Scale Insects that lay eggs and consequently hatch at one time, and apply a mild contact insecticide for them at exactly the proper time, or while the young are yet free-moving, delicate and unprotected. As the adults of those species which lay eggs die at the time the eggs are laid, and the life of the insect is continued only in the form of the living young at the time of the hatching of the egg, it can be seen that by thoro and proper application of the proper insecticide practically all of the brood, and consequently all specimens of the species found upon the tree or in the orchard at a certain time, can be killed at that particular time by spraying or fumigating. However, this also explains why those species of Scale Insects which bear living young, like the San José Scale, and do not die, but continue this method of reproduction for weeks, can not all be killed at one time by spraying or fumigating with sufficiently mild insecticides to kill the young only. The adult or mature pests of those species which bear living young, such as the San José Scale, will continue to live after contact applications have been made that are strong enough to kill their young on the same twigs as themselves, or even injure the foliage of the tree. The practical bearing of these points in the application of remedies for such insects is of exceeding importance.

Enemies.

There are many enemies of Scale Insects, which however are limited almost entirely to predaceous insects or internal parasites.

Among the former group are the Lady Beetles and their larvæ, the larval Lacewings and other insects, while among the latter or the internal parasites, are the minute parasitic wasps known as Chalcids, or Chalcid Flies, and Braconids. The predaceous insects feed mostly upon the very young, soft-bodied, free-moving Scale Insects, while the internal parasites attack and destroy the adults.

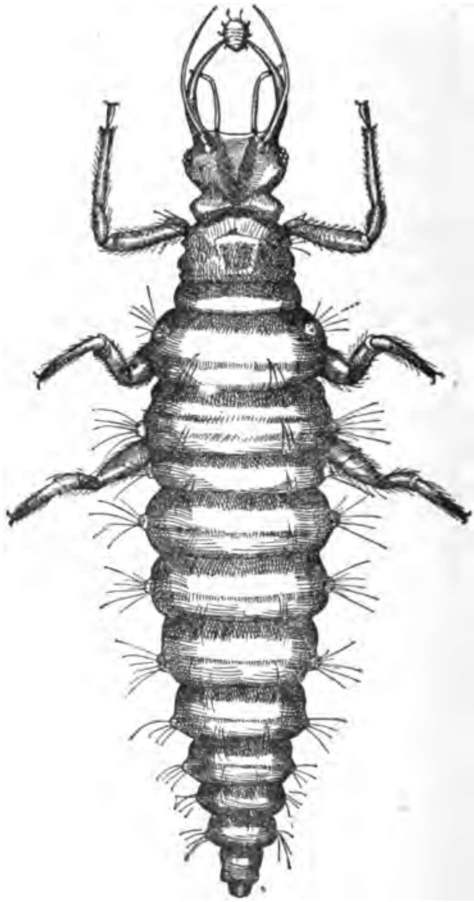


Fig. 25. An enemy of the San José Scale. Larva of the Lacewing Fly (Chrysopa sp.) killing young San José Scale. Drawn from specimen No. 6028c in the Office of the Economic Zoologist, by W. R. Walton, Artist.

We find, as a general rule, that the smaller the Scale Insect when mature or adult, the fewer the number of parasites infesting the same, and the difference of effect on the suppression is quite marked. Thus the San José Scale, being the smallest of all the Scale Insects, is too small to permit the internal parasites to find enough substance

in its body to come to maturity, and hence is rarely attacked by such beneficial creatures, if at all, while the large Turtle-shell Scale or Lecanium of the Poplar tree is so badly infested with internal parasites that its shells are often found thickly perforated with minute holes of the many parasites which have developed within each.

We have discovered and illustrated the unusual condition of the larva of a moth with insectivorous habits acting as an effective enemy of certain species of Scale Insects, belonging to the genus Lecanium, by feeding and living within the body of the insect, and there undergoing its transformation and remaining in the chrysalis.

Sub-Family I. Dactylopiinæ. The Mealy Bugs.

One group of Scale Insects known as Mealy Bugs, contains those that are covered by a white, granular, flour-like or meal-like substance, which is really a granulated waxy secretion which they have produced through pores in the skin. The little grains are arranged so closely together as to turn water from them and also protect them from their parasites and serve as a covering against sudden changes of weather. Thus it practically takes the place of the scale or covering and may be regarded as the scale in the beginning of its formation, where the wax has not yet been consolidated into one piece. These Mealy Bugs are found as very common pests upon the Coleus plant and other plants of greenhouses, and are quite too well known by lovers of potted plants. They are killed easily by spraying or sprinkling with soapy solutions or by dipping the infested plants into a weak Kerosene Emulsion, Kainit, or Muriate of Potash, dissolved in water at the rate of one ounce to a quart of water, has been found effective in killing these pests by dipping the entire infested plant into the solution. Tobacco Decoction, made by steeping one pound of Tobacco in a gallon of water for two hours, is also effective and will not injure the plants. This may either be sprayed over the plants or they may be dipped into it. The same treatment may be given with a solution of insect powder, using one ounce in two quarts of water. If many plants are to be treated Kerosene Emulsion may prove best and cheapest to use, making it about eight per cent.

Upon oak trees gall-like forms are to be found, often upon the stems or leaves. While some of these are true galls or vegetable growths, produced by insects stinging them and living within them, many are also scale insects, belonging to the genus Kermes. The resemblance of these Scale Insects to Plant Galls is very striking.

Upon Elm trees in this State is often found a peculiar Mealy Bug, belonging to the genus Gossyparia. This has the effect of stunt-

ing the growth of the tree, turning the leaves yellow, and causing them to drop prematurely. It sometimes covers the under sides of the branches until they look almost as white as though whitewashed. Spraying with eight or ten per cent. Kerosene Emulsion, or Whale Oil Soap Solution will destroy them.

Sub-family II. Coccinæ. The Soft Scales or Turtle-shell Scales.

Belonging to the Sub-family Coccinæ are peculiar Scale Insects covered with a greater or less amount of white waxy secretion, making some of them look as though they had an immense amount of wool attached, although these are not to be mistaken for the Woolly Aphids, so common upon injured places of apple trees. One species, belonging to the genus Pulvinaria, known as the Cottony Maple Scale, is very common indeed upon Maple trees grown as shade trees along streets, and many also infest Grape vines and other plants. Within its large cottony sack immense numbers of small eggs may be found, and consequently the scientific name of Pulvinaria innumerabilis is given to it. These pests often cover the twigs of trees to such an extent as to give the appearance that has been described as "popcorn on a stick." They are to be destroyed by spraying abundantly with either Kerosene Emulsion or Whale Oil Soap, one pound in six gallons of water. The soap solution enters the cottony mass and kills either the eggs or the young Scale Insects as they come through it after hatching.

There are an immense number of species of insects belonging to this Sub-family found in different parts of the earth, but their habits are more or less similar and the remedies are practically the same. It is one of the representatives of this Family, known as the Cottony Cushion Scale (Icerya) that was so very destructive in California but was effectively suppressed by the successful introduction of the Australian Lady Bird or Lady Beetle, which fed upon it and controlled it.

This is the most remarkable case of insect control by the introduction of the enemy of the pest that the world has ever known. Its success was so marked that it gave rise to great hopes of being able to control nearly all destructive insects apprehending and introducing their pests. This, however, has not been so marked for the treatment of any other known species. Reports are occassionally circulated to the effect that the San José Scale is being reduced by means of its natural enemies, but upon careful inspection, satisfactory proof can not be found for such reports.

Belonging to the Sub-family Coccinæ are the Turtle-shell Scale Insects, sometimes called Soft Scales and Terrapin Scales. These mostly belong to the genus Lecanium. They are mostly known to hor-

ticulturists, nurserymen and gardeners as Soft Scales. This is because the insect does not appear to be covered by a hard distinct shell as are some of the Scale Insects, but its skin is thickened and forms its shell, which is not readily separable from the body. Thus while it is possible to lift off the scale of most species discussed in the following Sub-family it is not possible to do this with the Soft or Turtle-shell Scale, because the hard covering is a portion of the body of the insect.

The Lecanium is one of the very serious enemies of peach and plum, especially from the central to the northern parts of Pennsylvania. It is often to be found covering the under sides of twigs and branches, and sometimes the leaves, to such an extent that it is impossible to put one's finger on the tree without at the same time touching these pests. Fortunately, where they are this numerous, their enemies often develop in considerable numbers and check them, but it is not safe to rely upon Nature to furnish control for such pests. They are large and conspicuous, hemispherical in shape and elliptical or circular in horizontal outline. Two or three species are known to attack the peach and plum, and a different species is also known upon plants in greenhouses and conservatories.

Orange, olive and lemon plants are especially liable to infestation by them.

A peculiarity in the life history of the Turtle-shell Scale Insects (genus Lecanium) is the fact that their young appear in late summer and are then dark-colored or reddish brown, flat and free-moving, but soon fix and feed to some extent and start their development, but remain exposed, often not one-fourth grown, upon the bare twigs during the severe winter weather. On tulip poplar trees, and the magnolia tree, the young of the large Magnolia Lecanium can thus be found at this time of year, while the large scales are dead, either by having completed their natural course of their life or by having been killed by parasites which have perforated their backs until they sometimes look like the lids of pepper boxes. Also upon the twigs of peach and plum trees at this time of year the young individuals of the Peach Lecanium are to be found. It is advisable to spray for them with the Lime-sulfur Wash in the fall of the year, as soon as practical after the leaves drop. It appears that for the Lecanium, the spring spraying as for the San José Scale, has not proven always as effective or satisfactory as has the same treatment for the last-named pest. However, we know where orchards in this State have been practically cleaned of the Soft-shell Scale by spraying with the Lime-sulfur Wash in the fall, and in some other orchards the pests have been killed by spring spraying with the same. The mixture is to be made and applied as directed

for the San José Scale in our October Bulletin, viz: 17 pounds of Sulphur, and 22 pounds of Lime, boiled one hour, and water added to make the solution up to 50 gallons, and thoroly sprayed over the trees, by two coats. Oils and soap solutions have not been wholly satisfactory for this particular Scale Insect and we do not recommend them for it. Of course, the remedy that is to be applied for this pest is also the one that is proper for the San José Scale, and in the spring of the year, before the bursting of the buds, is the time for spraying with the same material to prevent Peach-leaf Curl.

Trees that are infested with these Scale Insects may appear dwarfed, the leaves turn yellow and drop prematurely or become blackened as by a coating of soot. This black substance is a fungus which develops on the leaves or twigs beneath the Scale Insects where a sweet liquid has dropped from the pests, and is known as honey dew. To procure this liquid ants are generally seen climbing and descending the infested tree, and sometimes flies, bees and hornets hum around the tree thus infested to such an extent that their noise resembles that made by bees in swarming. Thus some Scale Insects produce honey dew which is sought by ants and winged insects the same as the honey dew produced by plant lice. There is, of course, no need of taking steps to prevent the ants from climbing the trees, as the proper course is spraying for the Scale Insects, and when they are destroyed the journeys of the ants will cease. Also it is not necessary to spray the leaves with a fungicide for the black fungus that develops upon them, but spray the tree at the proper time with an insecticide to destroy the Scale Insects.

The most of our Lecaniums are oviparous or egg-laying, the female leaving the eggs beneath her scale-like body and letting them there remain until they hatch, when the young, flat, elliptical dark-brown insects crawl forth and fix themselves upon the twigs and remain through the fall and winter undeveloped. It is evident that in Pennsylvania there is but one period or generation per year of any species of the genus Lecanium. The males appear in the summer, not a great while after the hatching of the eggs. Late summer applications of mild contact insecticides, such as one pound of Whale Oil Soap in six gallons of water, or eight per cent. Kerosene Emulsion, used thoroly as sprays, are recommended as excellent insecticides for such Scale. Those species of Insects of which the adults die and only the delicate young remain as the entire brood at a certain time, can be controlled by the fruit grower if he will watch the time of hatching of such pests and spray them just after they have hatched. However, if it should not be suitable to spray at such time he can also have recourse in the fall and spring spraying as for other scale insects.

Sub-family III. Diaspinæ. Armored Scale Insects.

One characteristic feature of the Scale Insects belonging to the Sub-family Diaspinæ, and known as the Armored Scale Insects, is that the body of the insect is covered with a scale, composed in part of the moulted skins and partly of a waxy secretion of the insect. This secretion comes through the pores of the skin and finally hardens into a scale which covers the very soft and delicate body and is practically free from the same after it has once formed. Thus the scale or covering of such insects can be removed leaving the insect natural and uninjured upon the place where it has been fixed.

In the Annual Report of the U. S. Department of Agriculture for 1880, Prof. Comstock has so well described the metamorphosis or transformation of the insects of this Sub-family that we can do no better than to quote the same.

"The newly-hatched scale-insect is oval in outline, much flattened, furnished with six legs, a pair of antennæ, and an apparatus for sucking the juices from plants. At this stage of its existence it is very small, a mere speck, which the untrained eye could only with difficulty detect. By means of a lens, however, these minute creatures can be seen crawling in all directions over the leaves or bark of an infested tree. After wandering for a time, usually but a few hours or even less, the young scale-insect settles on some part of the plant, inserts its beak, and drawing its nourishment from the plant, begins its growth at the expense of its host. In a short time there begins to exude from the body of the larva fine threads of wax, which are cottony in appearance. The excretion of this wax continues until the insect is completely covered by it. The rate at which this excretion is produced varies greatly. Thus larvæ of the red scale of Florida (*Aspidiotus ficus*), which were only one day old, were found to be completely covered by the cottony mass which they had excreted; while the larvæ of Glover's scale (*Mytilaspis Gloverii*) did not become entirely covered until they were six days old. Sooner or later the larvæ begins to excrete a pellicle, which, although very thin, is dense and firm in texture. The mass of cottony fibres either melts or is blown away, or, as in certain species of Aspidiotus, a portion remains as a white dot or ring in the centre of the scale. After a period, which, in several species that we have studied, is about one-half of the time from the hatching of the larva to the emerging of the male, or one-third of the time from the birth of the female to the date at which she begins ovipositing, the larva sheds its skin. In some species this does not take place until after the beginning of the formation of the permanent scale, and in such cases the moulted skin adheres to the inner surface of the scale; and cannot be seen while it is in its normal position on the plant. This

is true of many species belonging to the genus Aspidiotus (*A. ficus*, *A. Citri*, *A. perniciosus* and others). In these species the position of the exuviæ is indicated by a nipple-like prominence, often marked by a white ring or dot, which is the remains of the cottony mass first excreted. In these, the larval skin is plainly visible either upon the surface of the scale, as in certain species of Aspidiotus (*A. nerii*), and in Diaspis, or at one extremity, as in Mytilaspis. Sometimes, however, the larval skin is covered by a delicate transparent layer, which, I think, is the melted or compacted remains of the cottony mass excreted by the young larva.

The change which the larva undergoes at this moult is a very remarkable one, appearing to be a retrogression, instead of an advancement to a more highly organized form, as is the rule in the development of animals. With the skin are shed the legs and antennæ. The young scale-insect thus becomes a degraded grub-like creature, with no organs of locomotion. The mouthparts remain, however, in a highly developed state and are well fitted to perform their functions. This apparatus is not the least remarkable thing in the structure of these insects. It is terminated by a thread-like organ, which is frequently much longer than the body of the insect, and is composed of four delicate hair-like bristles. By means of this organ the insect is firmly attached to the plant, and draws its nourishment therefrom. From this stage the development of the sexes differs.

The second and last moult of the female takes place, in those species which we have studied most carefully, when she is about twice as old as when the first moult occurred. The change in appearance of this moult presents nothing remarkable. The second cast skin is joined to the first, and with it forms a part of the scale which covers the body of the insect. Sometimes, as in the genus Uhleria, this moulted skin is very large and constitutes the greater part of the scale, the greater part of it being excreted subsequently to the second moult. Soon after the second moult of the females takes place the adult males emerge, and doubtless the impregnation of the females occurs at once. After this, the body of the female increases in size, becoming distended with eggs. The oviposition takes place gradually, and in those species that we have studied, begins when the female is about three times as old as when the first moult occurred. The eggs are deposited beneath the scale, the body of the female gradually shrinking and thus making room for them. Some species, however, are viviparous.

The male scale-insect during the early part of is larval life is indistinguishable from the female. The first moult occurs at the same time and is accompanied by a similar change, the male larva,

like the female, losing its legs and antennæ. The second moult is also synchronous with the second moult of the female; but here the similarity in form between the two sexes ceases. Even before this moult takes place there may be observed the formation of rudimentary limbs beneath the transparent memberless skin of the larva; after this skin is shed, the male, now in pupa state, differs remarkably from the female. The male pupa has long antennæ, and its legs and wings, although in a rudimentary state, are very large. The duration of the pupa state in those species which we have bred, is short, lasting but a few days; and then, after a third casting of the skin, the adult male appears.

Plate XXVI, A represents the insect in this stage. The anterior wings, though very delicate, are large, and enable the male to fly readily. The posterior wings are represented only by a pair of halteres. These insects resemble in this respect the flies, gnats, and other insects belonging to the order of Diptera, or two-winged insects. The posterior end of the body is furnished with a style, which is sometimes nearly as long as the remainder of the body, and is the external organ of reproduction. As our figures represent only a dorsal view, the most remarkable character of the adult—the supplementary eyes which take the place of the mouthparts—is not shown."

While for the determination of the species of any Scale Insect it is necessary to use a compound microscope and critically examine minute details of structure, it is possibe to recognize the genera or major groups by a study of the external form of the shell with an ordinary hand lens. For this purpose a microscope with a power of at least ten diameters should be used, and the observer should be careful to place himself in such position as to receive the best possible light, falling over his shoulder and rendering the conditions favorable for careful examination.

A few of the genera of Armored Scales common in this State are as follows:

Aspidiotus.—This is the genus to which the Round-armored Scales belong, and of which the much dreaded and destructive San José Scale is a typical representative. There are over two dozen species known in the United States, many of which infest oranges, and other citrus fruits, others attack greenhouse plants, and others prove injurious to deciduous trees. The San José Scale, known as Aspidiotus perniciosus, has been described in detail in our previous Bulletins from this office, and for details as to food plants, life history and remedies the reader is referred to our October Bulletin. The San José Scale is distinguished by its strictly circular outline, the little point or tip in the centre, with a groove or disk around

the same. Other species do not have the groove around the central tip, or do not have this in the exact middle of the scale.

The European Fruit Scale is often found in Pennsylvania, especially upon cherry and plum trees, and is sometimes taken for the San José Scale. However, it is distinguished by its outline being elongate and slightly wider at one end, with the highest point toward one side. From the fact that specimens received at this office have been in a uniform stage of development, with all the adults dead and falling away at one time, as does the Lecanium after dying, we have reason to think that this species multiplies by laying eggs, which hatch in a brood, instead of bearing living young in continued succession, as does the San José Scale.

The numerous Scale Insects to be found upon greenhouse plants and potted plants are to be killed by one of the following means:

(1) Spray or wash with a strong Tobacco Decoction, made by steeping a pound of Tobacco in a gallon of water for two hours.

(2) Hold the infested plant in the steam of a teakettle at such distance as will be the extreme temperature that can be endured by the human hand.

(3) Dip the plant upside down into a tub of water as hot as the hand can endure.

(4) Fumigate with Tobacco Smoke.

(5) Fumigate with Carbon Bisulfid.

(6) Make a solution of Ivory Soap in water, using one pound in four gallons of water, add a few tablespoonsful of Ammonia to this, and spray the plants with it or dip them into it, or wash the infested plants with a sponge dipped into such solution. We recommend No. 5 as the best and most conveniently applied of the remedies here cited.

The genus Diaspis is commonly represented in this State by the Rose Scale, and is found as a snowy white scale commonly seen upon rose bushes, raspberries and blackberries. It is to be treated the same as the San José Scale, with the Lime-sulfur Wash in the fall or spring, or with milder contact insecticides during the summer. It should be understood that these pests do not generally spread to other varieties or kinds of plants, and there is no need to fear the spread to fruit trees of such an insect as the Rose Scale. Some of them, such as this species, may be decidedly limited in the range of their feeding, while others, such as the San José Scale, may occur upon any one of a great many different kinds of plants.

Chionaspis is the name of the genus to which the common Scurfy Scale or White Scale belongs. Our common Scurfy Scale on apple and pear is known by the scientific name of *Chionaspis furfurus*. The common name of this scale is given because it looks like a

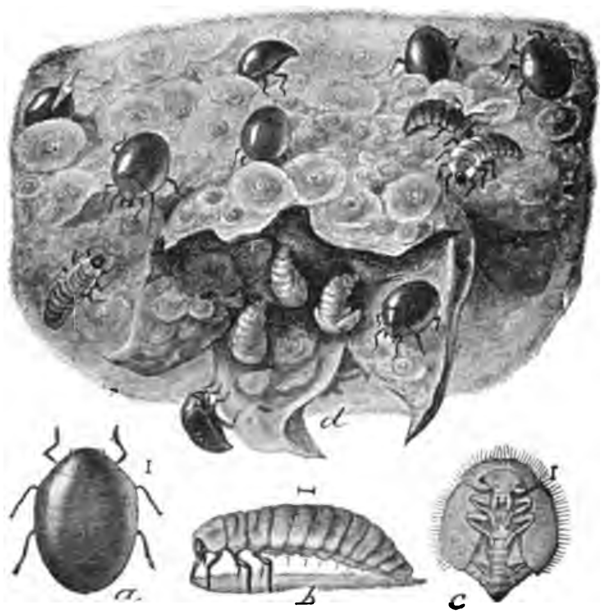


PLATE XXII.

Fig. A. Lady Beetles (*Pentilia misella*) devouring San José Scale. By Howard, in Bulletin No. 3. Technical Series, Division of Entomology, U. S. Department of Agriculture. Loaned by U. S. Department of Agriculture, Washington, D. C.

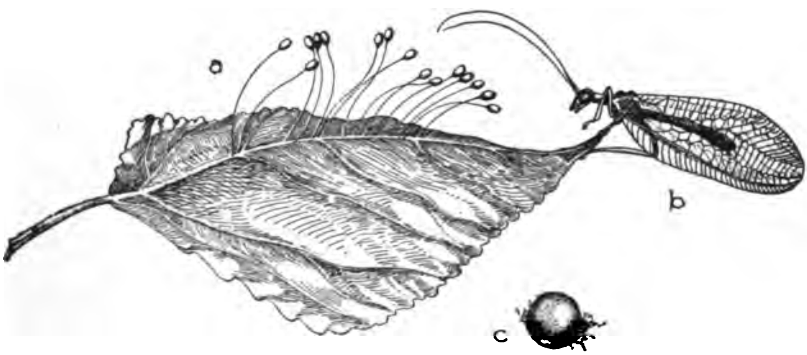


Fig. B. Lace-wing (*Chrysopa oculata*); (a) eggs on egg-stalks; (b) adult; (c) cocoon, enlarged 2 diameters. Drawn in the office of the Economic Zoologist by W. R. Walton. Specimens sent by the Zoological Society of Philadelphia.

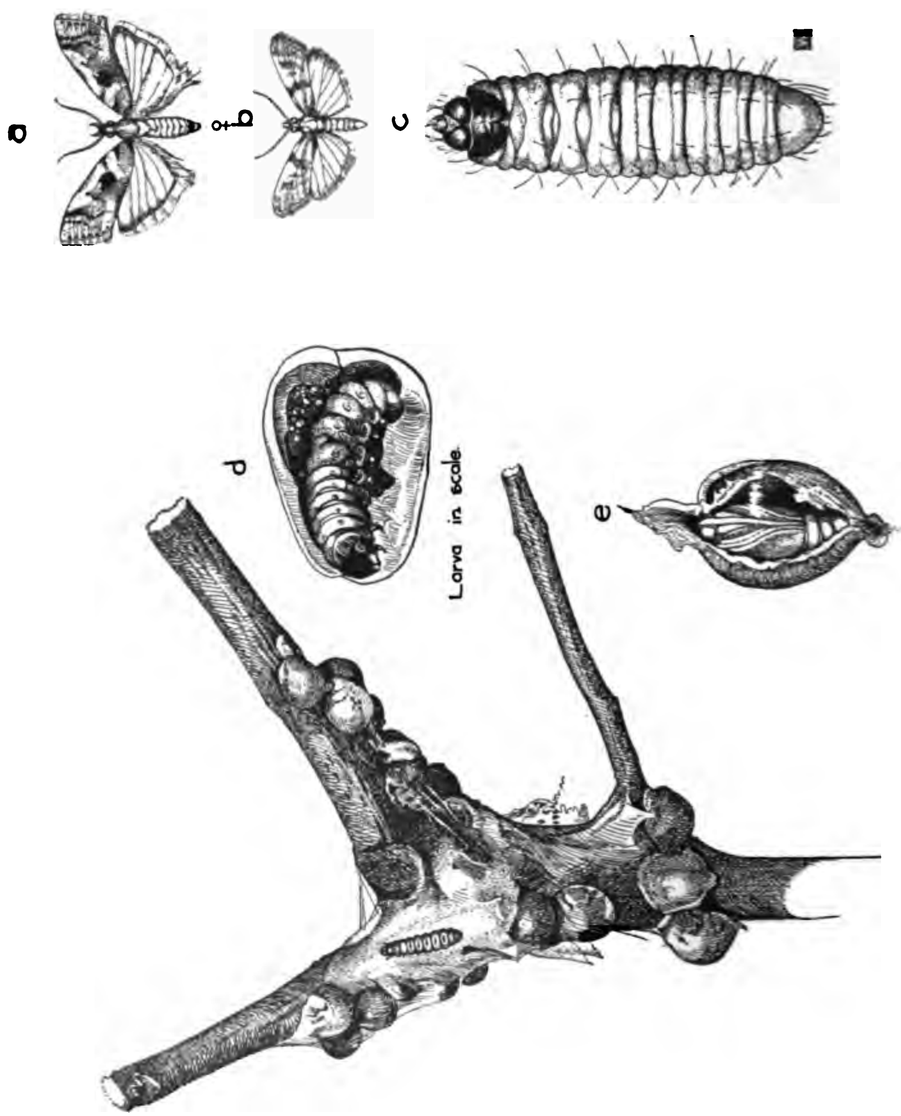


PLATE XXIII.

Moth Larvæ (*Lætilia coccidivora*) destroying Turtle-shell Scale (*Eulecanium tulipifera*) on Magnolia tree. (a) female, enlarged four diameters. (b) male, enlarged four diameters. (c) larva, enlarged ten diameters. (d) larva feeding within scale, enlarged seven diameters. (e) pupa within scale, enlarged five diameters. Drawn from Nature in the Office of the Economic Zoologist, by W. R. Walton.

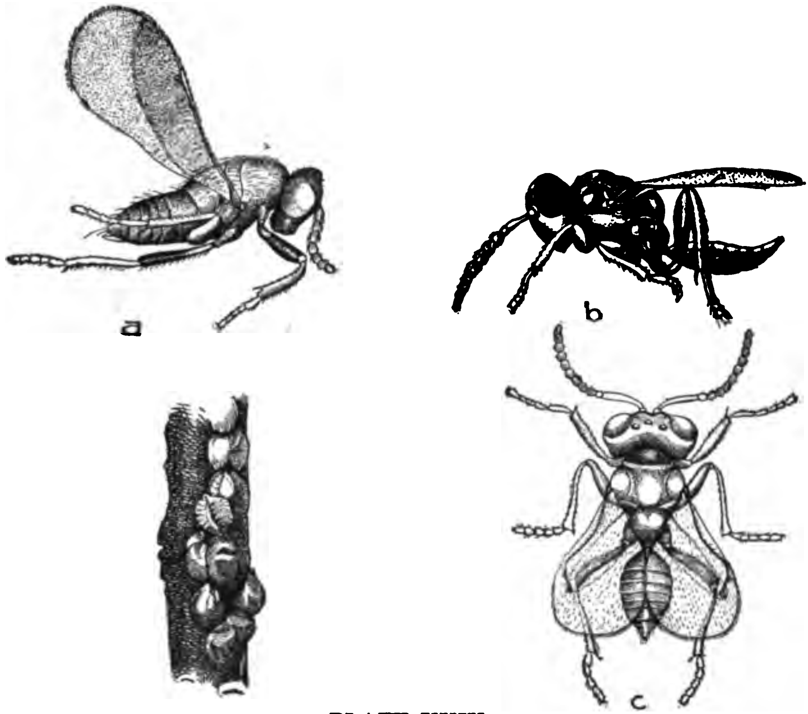
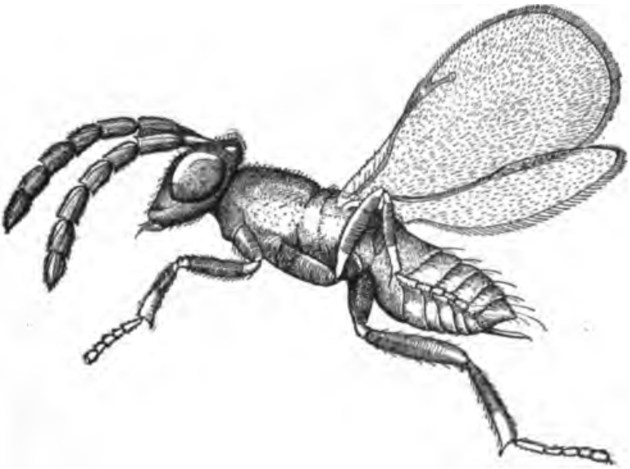


PLATE XXIV.

A. Lecanium sp. on Mulberry, slightly enlarged. Fig. a. *Coccophagus immaculatus* Howard, enlarged 30 diameters; b and c, *Pachyneuron micans* Howard, enlarged 30 diameters; Chalcid parasites bred from Lecanium. Drawn in the Office of the Economic Zoologist by W. R. Walton. Specimens sent by Mr. F. G. Stokes, of Philadelphia.



B. (*Phy cus varicornis* Howard) Chalcid Parasite of Scurfy Scale of Pine, enlarged 65 diameters. Drawn in the Office of the Economic Zoologist, by W. R. Walton.

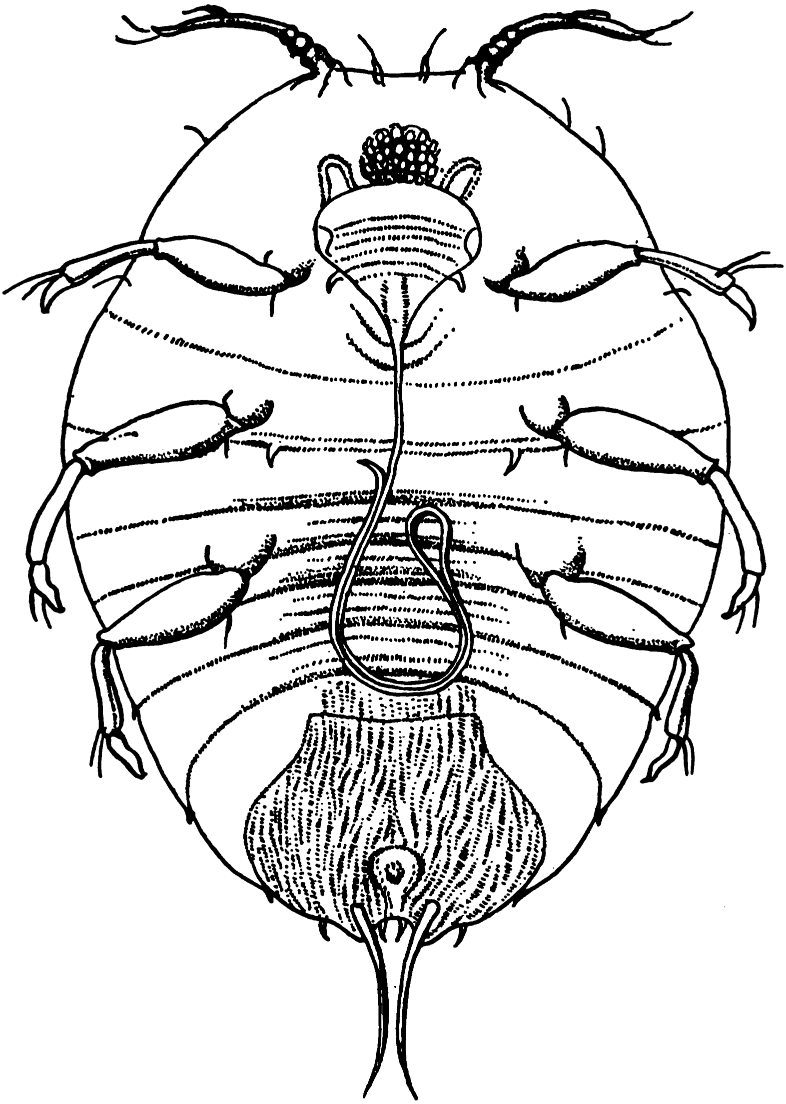


PLATE XXV.

Under side of young San José Scale, very greatly enlarged, showing the very long proboscis like a whip-lash. Drawn from Nature by W. R. Walton in the Office of the Economic Zoologist.

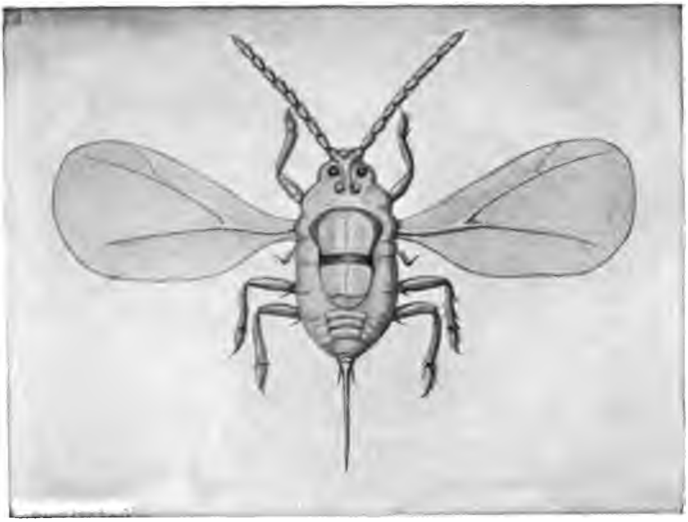


PLATE XXVI.

A. Male San José Scale, greatly enlarged. Drawn by W. R. Walton, Artist, in the Office of the Economic Zoologist, Harrisburg, Pa.

B. Rose Scale (*Diaspis rosæ*) on raspberry. A scale insect quite different from the others previously discussed in these Bulletins, which attacks rose, raspberry, etc., and is to be killed by the same remedies as for the San José Scale. Photographed in the Office of the Economic Zoologist. Natural size.

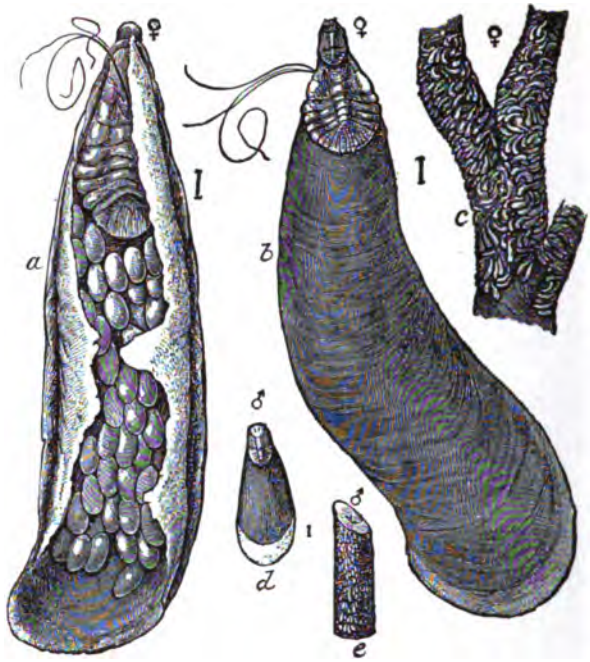
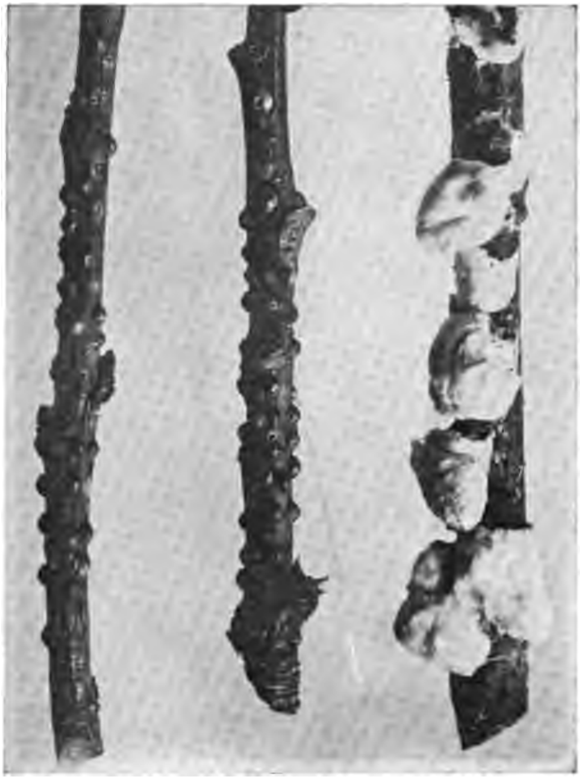


PLATE XXVII.

Fig. 1. Oyster-shell Scale (*Mytilaspis pomorum*) a. Under side of female scale, showing eggs as seen during Winter and Spring; b, upper side of same; c, female scales, natural size, as seen on badly infested branch; d, male scales; e, branch covered with male scales. c and e are natural size, and a, b, and d are greatly enlarged. The straight lines at right of a and b indicate their natural size. (From Howard, in Yearbook of U. S. Dept, of Agr.)

Fig. 2. Scurfy Scale (*Chionaspis furfurus*) ; a, female, and b, male on twigs, natural size; c, female scale, upper view, much enlarged; d, male enlarged. (From Howard, in Yearbook of U. S. Dept. of Agr.)



a b c

PLATE XXVIII.

a. Lecanium or Turtle-shell Scale on Maple. b. Lecanium or Turtle-shell (Soft Scale) on Plum. c. Cottony Maple Scale. All natural size. Photographed in the Office of the Economic Zoologist.

PLATE XXIX.

a. Scurfy Scale. Small specks, males; large ones, females. b. Scurfy Scale. All females, adult. C. Oyster-shell Scales. All natural size. Photographed in the Office of the Economic Zoologist.

blotch of scurf or dandruff fallen upon a limb. This insect reproduces by laying eggs, and produces two generations per year. The first lot of eggs hatches about the 20th of May, at an average date in this State, and the young insects, which are dark red in color, crawl about for a day or two, then fix themselves and complete their development and lay eggs which hatch during the month of August. The insects from this brood complete their development before winter and lay eggs and die. The two sexes of Scurfy Scale are well marked and easily distinguished. The females are fanshaped and large enough to be distinguished readily by the unaided eye, while the males are but narrow white blotches, often crowded together in numbers upon some parts of the branch where the females are not found so abundantly. During the winter time if the larger or female scales be raised and examined, from twenty to thirty dark red eggs will be found beneath them. The eggs and young of this genus can always be known by the dark red color, as can also the bodies of the parents.

Mytilaspis is the genus to which the Oyster-shell Scale belongs. These are sometimes called Bark Lice, Oyster-Shell Bark Lice, etc. The species most commonly found in this State upon apple, pear and plum is known by the scientific name *Mytilaspis pomorum*. There are different species of this genus, one being found upon the orange and commonly sent to us upon the skin of oranges imported as food. The latter is known as *M. Gloverii*. It is recognized by the narrow form of the scale, slightly smaller size and less curving than the Apple Tree oyster' shell. The Oyster-shell Scales are so called because of their general resemblance to the shell of an oyster. They are hard, elevated, a variable brown in color and conspicuous. They are found upon most lilac bushes, and in fact these are the chief enemies of the. lilac. The males are distinguished by their smaller size and less.curvature of shell.

In Pennsylvania there are two broods of the Oyster-shell Scale per year, the same as with the Scurfy Scale. However, these hatch a little earlier than the Scurfy, as the first brood of the Oyster-shell appears in this State on the average, about the 10th of May, and the second brood during the early part of August. The young Oyster-shell Scale Insects are milky white or pearly white in color, and the bodies of the insects beneath their scales and the eggs of this genus are also the same color. In the fall of the year the female lays her eggs beneath the shell, and her body gradually shrivels and dies, leaving the eggs to occupy the greater portion of the space that had formerly been taken by the living body, the same as with the flatter and whiter Scurfy Scale. If during the fall, winter or early spring, the shell of the Oyster-shell Scale be lifted, there will

be found beneath it from thirty to forty milk white eggs, snugly arranged in rows. When these hatch, about the second week of May, is the time to apply mild contact insecticides to destroy them. However, they can also be killed by spraying with the Lime-surfur Wash in the same manner and at the same time as has been recommended for the San José Scale.

We have received reports of badly infested orchards being freed from the Oyster-shell Scale by spraying. A remarkable case was that of Hon. H. E. Little, the late Secretary of the Wyoming County Horticultural Society, of Tunkhannock, Pa., in whose orchard we gave a demonstration in the latter part of November, showing the method of preparing and applying the Lime-surfur Wash for the San José Scale. Some of his trees were badly infested with the last-named pests, and others were badly injured by the Oyster-shell Scale, the bark being in fact entirely covered, while others had both pests upon them. A year after the application Mr. Little came personally to report to us that the spraying had entirely cleaned the bark of his trees, and on many he could find no living pests whatever of either species, and that very few living San José Scale or Oyster-shell Scale remained in the entire orchard. This is a remarkable case of almost eradicating two species of destructive Scale Insects by one fall spraying alone, and that upon apple trees, where it is generally supposed to be more difficult to kill the Scale Insects than upon peach trees.

The Oyster-shell Scale is found very abundant upon apple, pear, plum, poplar, willow, lilac, soft maple and ash trees in the central and northern portions of Pennsylvania, and is sometimes so abundant upon maple, poplar and apple trees as to prove destructive to them. In regions where the San José Scale has not yet occurred in abundance, the Oyster-shell Scale may be the chief of the Scale Insects needing attention.

Poplar and soft maple trees planted for shade along streets or for other purposes are often seriously infested by the Oyster-shell Scale. A forest of South Carolina poplar trees was planted by the Tyrone Paper Company, on a hillside overlooking Tyrone, Pennsylvania, and was soon found to be badly infested by this pest. We recommended spraying with Kerosene Mixture, using about ten per cent. Kerosene. This was done with care about the first of August, and being applied at about the time the second brood was hatching, it was very successful and resulted in cleaning up and saving a large grove of badly infested trees. The chief point of this work was the time of the year in making the application of the dilute insecticide. The foliage of the trees was, of course, not injured.

It will be noted that in the above description of Scale Insects we have referred to the distinguishing color of eggs and young. We believe it possible to determine the genera of the common Scale Insects by these colors alone. For example, the young of the San José Scale, and also the body of the adult as when found alive under the shell, is exactly the color of sulfur or a ripe lemon; the eggs and young of the Rose Scale are pink; the eggs and young of the Scurfy Scale are dark red or turkey red; the eggs and young of the Oyster-shell Scales are milky white. The bodies of the adult scales when alive and in thriving condition and found beneath their protecting scales are practically the same color as their eggs or young. This is an important criterion in aiding to determine whether or not the insect is dead.

Many persons who apply insecticides wish to know if these have been effective in killing Scale Insects. From an external examination of the protecting scale alone, it is entirely impossible to tell if the pests have been killed by any application that may have been made to them. It is possible where the pests are numerous to rub a knife blade or some blunt firm instrument over them with great pressure, and if an oily juice can be pressed out, the operator is safe in inferring that the insects are yet alive, but if they be so dry that no liquid can be pressed out of them, they are no doubt dead. However, the correct and safe method of determining whether the Scale Insects be alive or dead is to lift the protecting scale and examine the body with a microscope. If it be shriveled, shrunken or discolored, it is dead; but if plump, full and juicy and possesses its normal color, as described above, it is alive.

We desire to make a further study of the Scale Insects of Pennsylvania with a view toward publishing detailed dates of appearance, stages, food plants, and enemies of the same, and cordially invite persons interested to aid these studies by sending us specimens by mail. They will be named free of charge, with both common and scientific names, and literature will be sent free concerning them. In mailing such specimens to us the contributor should kindly give the date, locality, and name of collector, as well as the food plant on which they are found, and wrap the specimens in soft paper, but not in cotton. Place the name of the sender on the package and mail it to H. A. Surface, State Zoologist, Harrisburg, Pa.

THE SAN JOSE SCALE REMEDIES.

(Concluded from the October Bulletin.)

III. SOAP SOLUTIONS.

Soap solutions can be made to kill San José Scale if used strong enough, but it requires a greater proportion of soap than most people think necessary. To dissolve the soap use hot water.

(h) Whale Oil Soap.

Whale Oil Soap is a good insecticide when used in the proper strength and at the right time. During the summer while trees are in leaf it can be applied, dissolved in water, at a strength of one pound in five or six gallons, to destroy young scale insects and all kinds of plant lice. It is valuable for holding San José Scale in check during the summer, as it will do this without injuring the foliage, and is cheaper and more efficient than most of the commercial preparations that are given special "trade" names. During the time when the leaves are off the trees it should be applied at a much greater strength in order to kill off the older San José Scale. That which has been found most effective has been two pounds of Whale Oil Soap dissolved in one gallon of hot water and applied either as a wash or as a spray. This can be used with safety to the trees at a strength sufficient to kill the pest at any time when the leaves are off, although some persons claim that a fall application will injure the fruit buds and that the only proper time to apply a strong solution of Whale Oil Soap, in order to kill the scale and at the same time not injure the buds, is in the spring just before the leaves appear. We are conducting experiments with this at present and hope to report on them again next spring.

(i) Soft Soap, Laundry Soap, Etc.

Good old-fashioned country soft soap can be used to kill the Scale without injury to the trees by making it as thick as house paint and applying it with a brush or sprayer at any time when there are no green leaves to be injured by it. The chief point is to be careful to cover all the bark from the tip of the furthest twig to the base of the tree. Equal parts of soft soap and warm water will do the work. Common laundry soap, shaved fine and dropped into hot water, made into a strong solution, using at least three pounds of such soap to a gallon of water will kill the scale. Where there are only a few trees such remedies are to be rcommended, but where many trees are to be treated this becomes too expensive. The strong soap solution may be applied with brushes if care be taken to cover every part.

SUMMARY OF RESULTS IN OTHER STATES.

The manufacturers and agents of commercial insecticides have so unjustly and unmercifully criticized the writer for advocating the boiled Lime-sulfur Wash as both the best and cheapest remedy for the San José Scale that he takes pleasure in publishing below extracts from various publications of the United States Government and State Experiment Stations, in which the writer gives the results the operator experienced:

The United States Department of Agriculture.—"Experiments have yielded such gratifying results that the remedy (Lime-sulfur Wash) is now widely used and recommended by the Bureau of Entomology and various experiment stations. The chief advantage which this wash seems to possess are that it is highly effective in the destruction of the San José Scale, other scale insects, plant lice, and other similar pests. It also controls to a large extent the development of certain fungous diseases such as Peach-leaf Curl." U. S. Farmers' Bulletin No. 127, page 19.

Alabama Experiment Station.—"The spray in most general use, and at present most satisfactory, is the so-called Lime-sulfur salt Spray." Bulletin 139, page 17.

Arkansas Experiment Station.—"The best remedy for the San José Scale is the so-called Lime-salt-surphur Wash." Bulletin No. 92. "Salt is now commonly deemed unnecessary. The Lime and Sulfur Wash requires thorough cooking as essential to its effectiveness against the San José Scale." Arkansas Experiment Station Bulletin No. 95, page 71.

California Experiment Station.—"Whenever it appears upon deciduous trees, winter spraying with the Lime-salt-surfur should be resorted to." Report California Experiment Station, 1901. part 1.

Colorado Experiment Station.—"This wash, when properly made, is one of the most effectual applications for the destruction of scale insects and eggs of the brown mite." Bulletin No. 114, page 37.

Connecticut Experiment Station.—"In a general way, however, Table VII shows that all of the lime and sulfur mixtures were fairly effective in destroying the scale, whether applied in fall or spring." Connecticut Agricultural Experiment Station Report for 1906, page 290.

Delaware Experiment Station.—"If the San José Scale is present and has not been practically vanquished by fall and spring spraying, then the K-L-B-P (Kerosene-Lime-Bordeaux-Poison) is by far the best spray mixture to use." Delaware Experiment Station Bulletin No. 76, page 18.

Georgia Experiment Station.—"Georgia fruit growers in many parts of the State, have, during the past few years, demonstrated beyond question the value of lime and sulfur as a remedy for the San José Scale. Hundreds of orchards that have been sprayed each winter for the past four or five years, silently testify to the value of the boiled lime and sulphur wash." Bulletin No. 21, pages 203-204.

Illinois Experiment Station.—"The cheapest and most efficient of the eleven insecticide mixtures thoroughly tested against San José Scale were the simple lime and sulfur mixtures (without salt or blue vitriol) dissolved by boiling together." Bulletin No. 107, page 260.

Purdue University Experiment Station.—"The best remedy known at the prest time is the lime-sulfur wash." Bulletin No. 118, page 417.

Iowa Experiment Station.—"It has proved very efficient against the San José Scale and it is likewise destructive to the oyster-shell scale, the scurfy scale, the case bearers and certain other insects which pass the winter in some form on the trees." Bulletin No. 89, page 18.

State Crop Pest Commission of Louisiana.—"By many years of work, however, the wash known as the lime-sulfur wash has been developed to a high point of efficiency, and is almost universally used in controlling the San José Scale in orchards." Circular No. 12, page 5.

Maryland Experiment Station.—"In view of the results recorded in this Bulletin, and the observations made in the various parts of the State, there seems to be no spray that can be recommended for the control of the San José Scale, except the lime, sulfur and salt solutions." Bulletin No. 99, page 88.

Massachusetts Experiment Station.—"A summary of the experimental treatment for the scale, made in this country, indicates that there is nothing better than the lime-sulfur where boiling is possible." Bulletin No. 116, page 22.

New Jersey Experiment Station.—"Lime, sulfur and salt, as a winter wash, maintained its standard of effectiveness on peach and plum, and did better on apple and pear than in 1903-1904." Bulletin No. 186, page 5.

New York Experiment Station.—"Winter treatment: Lime and sulfur wash. This mixture has considerable value as a fungicide. It prevents curl leaf and has in some cases prevented apple and pear scab." Bulletin No. 245, page 134.

North Carolina Experiment Station.—"The remedy which is at the present time most widely used against the San José Scale is the Lime-sulfur Wash, applied with a spray pump." Bulletin No. 5, Vol. 28, page 19.

Ohio Experiment Station.—"If San José Scale is present, spray with lime-sulfur wash. This will also prevent leaf curl." Circular No. 52, page 3.

Oregon Experiment Station.—"This wash is the most satisfactory for San José Scale and also a good fungicide." Bulletin No. 93, page 46.

South Carolina Experiment Station.—"There are several remedies which have been found effective against the scale, but the kerosene treatment is undoubtly the best and cheapest." Bulletin No. 65, Page 5.

Tennessee Experiment Station.—"The lime-sulfur wash from the standpoint of cheapness, accessibility and efficiency is the best spray now known for the San José Scale." Bulletin No. 4, page 13.

Vermont Experiment Station.—"The best known remedy at the present time is the lime-sulfur wash, which should be applied in this section in the early spring." Bulletin No. 129, pages 126-7.

Viriginia State Crop Pest Commission.—"We still recommend the Lime-sulfur Wash as the cheapest and most effective for general orchard work." Circular No. 2, New Series, page 11.

West Virginia Experiment Station.—"None of them (the commercial insecticides), however, seem to possess the fungicidal properties of the lime and sulfur sprays, but as scale killers some, at least, are entirely satisfactory and greatly simplify the matter of combating scale insects on fruit trees." Bulletin No. 107, page 353.

SPECIMENS RECEIVED DURING JULY, 1907.

Number.	Specimens.	Date—July, 1907.	Name and Address.
	Reptiles and Batrachians.		
9686	(a) Grass Snake (Liopeltis vernalis), ... (b) Purple Salmander (Gyrinophyllus porphyriticus), ...	1	W. W. Long, Washington.
9687	Pilot Snake (Callopeltis obsoletus),	1	W. Gummo, Farrandsville.
9688	Common Garter Snake (Thamnophis sirtalis), ...	1	B. Geoggler, Tobyhanna.
9689	Copperhead Snake (Agkistrodon contortrix), ...	1	R. W. Wehrle, Indiana.
9702	House Snake (Lampropeltis triangulus), ...	1	J. B. Richard, Barto.
9703	Common Garter Snake, ...	1	P. S. Tooker, Easton.
9709	(a) Meadow Frog (Rana palustris), ... (b) Cave Salamander (Spelerpes longicauda), ...	2	W. O. G. and H. K. West, Danville.
9710	Varied Tree Frog (Hyla versicolor), ...	2	W. Packard, Pennwyn.
9711	Pilot Snake, ...	2	J. B. Fink, Shickshinny.
9712	(a) Spotted Salamander (Amblystoma punctatum), ...	2	Mrs. S. M. Kranmer, Granville Summit.
9715	Common Water Snake (Natrix sipedon), ...	2	J. Bunnell, Farrandsville.
9716	Copperhead Snake, ...	2	J. K. West, Danville.
9732	2 Hoptoads (Bufo lentiginosus americanus), ...	2	B. Coover and R. Martin, Harrisburg.
9733	(a) 2 Common Water Snakes, .. (b) 2 Painted Turtles (Chrysemys picta), ... (c) Speckled Turtle (Clemmys guttatus), ... (d) Red Salamander (Spelerpes ruber), ...	2	C. L. Gruber, Kutztown.
9734	(a) Pilot Snake, ...	2	R. E. Bonner, Royalton.
9743	Granite Salamander (Plethodon glutinosus), ...	3	R. W. Wherle, Indiana.
9745	Rattlesnake (Crotalus horridus), ..	3	L. Lantz, Farrandsville.
9747	Red-bellied Snake (Storeria occipitomaculata), ...	3	D. D. Bauman, Sand Patch.
9748	Ribbon Snake (Thamnophis sauritus), ...	3	E. A. Weimer, Lebanon.
9749	Ribbon Snake, ...	3	N. Phillips, Tioga.
9750	(a) Common Water Snake, ...	3	Miss C. B. Steele, Tioga.
9751	Pilot Snake, ...	3	J. C. Buxton, Independence.
9752	Copperhead Snake, ...	3	M. M. Kauffman, Clarion.
9768	Common Water Snake, ...	5	E. Burnell, Farrandsville.
9770	Blacksnake (Bascanion constrictor), ...	5	G. R. Ross, Lebanon.
9771	2 House Snakes, ...	5	A. J. Tatlow, Rydal.
9772	Copperhead Snake, ...	5	M. F. Kauffman, Clarion.
9774	Blacksnake, ...	5	S. C. Snowden, Dayton.
9790	Blacksnake, ...	6	A. S. Staggerwalt, Bowmanstown.
9792	House Snake, ...	6	A. W. Smith, Blairsville.
9793	2 Pilot Snakes, ...	6	R. W. Wherle, Indiana.
9794	(a) Common Garter Snake, ... (b) Common Water Snake, ... (c) Ring-necked Snake (Diadophis punctatus), ...	6	G. W. Gordon, Brownsville.
9801	House Snake, ...	8	L. G. Schaum, Ryeland.
9803	House Snake, ...	8	C. A. Benner, Farrandsville.
9824	Spotted Salamander, ...	9	J. M. Mossher, New Milford.
9846	Common Garter Snake, ...	10	G. Bohn, Lickdale.
9847	Ring-necked Snake, ...	10	Mrs. S. W. Kranmer, Driftwood.
9848	Bull Frog (Rana catesbeana), ...	10	——, Harrisburg.
9865	(a) 2 Sculptured Turtles (Clemmys insculptus), ... (b) House Snake, ...	10	W. Angus, Stoddartsville.
9868	Pilot Snake, ...	10	H. A. Brightbill, Marsh Run.
9869	Rattlesnake, ...	10	R. Kretzing, Marsh Run.
9874	Rattlesnake, ...	11	R. L. Jackson, McConnellsburg.
9875	(a) 2 House Snakes, ... (b) Common Garter Snakes, ...	11	W. Angus, Stoddartsville.
9876	Common Garter Snake, ...	11	C. A. Benner, Farrandsville.
9877	Brown Snake (Haldea striatula), ..	11	F. M. Arnold, Jr., Clarion.
9900	Rattlesnake, ...	11	J. W. Pressler, Nittany.
9901	(b) 3 Hellbenders (Cryptobranchus alleganiensis), ...	12	R. W. Wehrle, Indiana.
9902	Varied Tree Frog, ...	12	I. Leibersperger, Fleetwood.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9904	Red-bellied Snake,	12	W. C. Hughes, Tioga.
9915	Tree Lizard or Swift (Sceloporus undulatus),	13	H. M. Sternbergh, Reading.
9916	2 Rattlesnakes,	13	M. M. Kaufman, Clarion.
9922	Turtle Eggs,	13	J. W. Miller, Fort Hunter.
9928	Copperhead Snake,	15	Miss M. C. Brightbill, Marsh Run.
9929	Common Garter Snake,	15	L. I. Seaman, Cresson.
9930	Snapping Turtle (Chelydra serpentina),	15	J. Couch, Cannonsburg.
9931	Turtle Eggs,	15	W. P. Becker, Eshbach.
9934	(a) Musk Turtle (Aromochelys odoratus), (b) 2 Painted Turtles, (c) 3 Green Frogs (Rana clamitans), (d) 3 Meadow Frogs,	15	C. L. Gruber, Kutztown.
9946	Pilot Snake,	16	R. W. Wehrle, Indiana.
9947	Copperhead Snake,	16	E. E. C. Gibbs, Huntingdon.
9948	Blacksnake,	16	C. L. Gruber, Kutztown.
9949	Pilot Snake,	16	D. H. Uncapher, Ebensburg.
9950	House Snake,	16	C. L. Erhardt, Edenville.
9951	Common Garter Snake,	16	M. R. Good, Narvon.
9968	Sculptured Turtle,	16	C. Fegley, Harrisburg.
9981	Red-bellied Snake,	17	Mrs. S. W. Kranmer, Driftwood.
9982	Rattlesnake,	17	R. L. Jackson, McConnellsburg.
9983	Muhlenberg's Turtle (Clemmys muhlenbergi),	17	S. Omensetter, Media.
9986	Varied Tree Frog,	17	Mrs. A. F. Hughes, Tioga.
9987	Cave Salamander,	17	D. H. Bauman, Mance.
10003	(a) Box Tortoise (Terrapene carolina), (b) 4 House Snakes, (c) Grass Snake, (d) Common Garter Snake, (e) Purple Salamander,	18	N. E. Solt, Weissport.
10004	(a) House Snake, (b) Common Garter Snake,	18	G. W. Mayer, Franklin.
10015	House Snake,	18	J. S. McClay, Irvona.
10021	Common Garter Snake,	19	H. N. Partington, Harrisburg.
10022	Varied Tree Frog,	19	H. H. McGinnis, Emlenton.
10031	(a) Common Water Snake, (b) Newts (Diemictylus viridescens), (c) Box Tortoise, (d) 2 Painted Turtles, (e) 2 Green Frogs (Rana clamitans),	19	F. D. Keboch, Williamstown.
10039	Common Water Snake,	19	B. F. Swant, Crowl.
10040	Box Tortoise,	19	W. F. Dague, Mt. Alto.
10041	Blowing Viper (Heterodon platirhinos),	20	H. Fittry, Pleasant Ridge.
10042	House Snake,	20	L. B. Gilmore, Saegertown.
10043	House Snake,	20	H. Albert, Kratzerville.
10067	Common Garter Snake,	22	W. Schradley, Harrisburg.
10071	Blacksnake,	22	J. McCormick, Wilmore.
10072	Blowing Viper,	23	H. I. Grove, Sherleysburg.
10073	Copperhead Snake,	23	E. E. C. Gibbs, Huntingdon.
10074	(a) Pilot Snake, (b) House Snake,	23	E. Neal, Delmont.
10075	Common Garter Snake,	23	A. C. Rapp, Tylertown.
10076	(a) 4 Land Salamanders (Plethodon cinereus), (b) Granite Salamander,	23	C. D. Richards, Easton.
10089	Common Garter Snake,	23	Mrs. J. H. Stone, Stroudsburg.
10090	House Snake,	23	Miss L. Stewart, Oakdale.
10094	Common Garter Snake,	24	O. S. Gottshalk, Iron Bridge.
10095	Common Garter Snake,	24	W. Schradley, Harrisburg.
10114	Rock Snake (Storeria dekayi),	24	B. Matter, Harrisburg.
10120	(a) House Snake,	25	R. Templeton, Ulster.
10121	(a) Common Garter Snake,	25	Anna K. Bewley, Forest Grove.
10122	House Snake,	25	E. P. Staggerwalt, Bowmanstown.
10123	House Snake,	25	B. H. Bauman, Mance.
10124	Snake (Lampropeltis doliatus coccineus),	25	F. S. French, Bosburg.
10125	(a) Eggs of Snapping Turtle, (b) House Snake,	26	R. W. Wehrle, Indiana.
10126	Blowing Viper,	25	C. W. Hardt, Wellsville.
10127	Rock Snake,	25	A. Schradley, Harrisburg.
10143	Painted Turtle,	26	S. Baldy, Catawissa.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
10145	Common Garter Snake,	26	A. A. Wood, Coudersport.
10147	Newt,	26	D. H. Bauman, Mance.
10148	Pilot Snake Eggs,	26	J. F. Beecher, Kerrsville.
10159	House Snake,	26	A. C. Rapp, Kylertown.
10161	Pilot Snake,	27	C. F. Peters, Farrandsville.
10168	Newt,	29	E. H. Bauman, Mance.
10169	Pilot Snake,	29	A. S. DeWitt, Fisher's Ferry.
10170	Common Garter Snake,	29	W. C. Hughes, Tioga.
10171	Pilot Snake,	29	A. W. Smith, Blairsville.
10172	(a) Box Tortoise, (b) Common Garter Snake,	29	W. Trageser, York.
10174	House Snake,	29	Mrs. R. S. Hampton, Union City.
10189	Blowing Viper,	30	L. G. Schaum, Womelsdorf.
10190	(a) Rattlesnake, (b) Blowing Viper,	30	E. W. Tomkins, Eatonville.
10191	Rattlesnake,	30	R. L. Jackson, McConnellsburg.
10192	Hoptoad,	30	Blyson Camping Party, Blyson-on-the-Clarion.
10193	Common Garter Snake,	30	S. Allabach, Farrandsville.
10208	Grass Snake,	30	F. G. Couch, Andersonburg.
10216	House Snake,	31	C. A. Palmer, Warfordsburg.
10226	Painted Turtle,	31	S. Wilson, Harrisburg.
	Birds and Mammals.		
9113	Vesper Sparrow,	2	A. D. Miller, Barnesville.
9744	Star-nosed Mole,	3	R. Davis, Lansford.
9746	Cedar Waxwing,	3	D. B. D. Beaver, Reading.
9769	(a) Meadow Mouse (Microtus pennsylvanicus),	5	W. Angus, Stoddartsville.
9773	Common Weasel (Putorius noveboracensis),	5	R. W. Wehrle, Indiana.
9845	Common Weasel,	9	E. C. Eterich, Aldenville.
9901	(a) Common Weasel,	12	R. W. Wehrle, Indiana.
9905	Long-eared Owl,	12	B. M. Stone, Stull.
10144	Green Heron,	26	C. W. Hart, Camp Hill.
10125	Woodcock,	25	R. W. Wehrle, Indiana.
10162	Racoon,	27	N. Fisher, Wellsboro.

SPECIMENS RECEIVED DURING AUGUST, 1907.

For each entry of which the species is determined a common specific or general name is given, followed by the scientific name. Following entries are given with the common name when that is specific, and with the scientific name when the common name is not specific name, allowing the contributor to follow the list back for the general name.

Number.	Specimens.	Date—August, 1907.	Name and Address.
	Insects.		
10238	Grape Berry Moth Larvæ (Polychrosis botrana),	1	T. T. Miller, Chestnut Hill.
10239	Bag Worms (Thyridopterx ephemeraeformis),	1	F. M. Bream, Gettysburg.
10240	Dogbane Beetle (Chrysochus auratus),	1	J. B. Small, Leechburg.
10242	Hummingbird Moth (Ampelophaga myron),	1	E. E. C. Gibbs, Huntingdon.
10244	Oyster-shell Scale (Lepidosaphes ulmi),	1	R. B. Young, Hazleton.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10247	(c) Beetle larvæ, ... (d) Milkweed Beetle (Tetraopes tetraophthalmus), ...	2	R. E. Scheoner, Stouchsburg.
10248	Milkweed Butterfly Pupa (Danais plexippus), ...	2	Rev. R. H. MacDade, Oaks.
10249	Abbot's Sphinx larva (Sphecodina abbottii), ...	2	Miss E. G. Ryman, Dallas.
10250	Cutworm (Noctua c-nigrum), ...	2	S. H. Dean, Mt. Carmel.
10251	Aphids, ...	2	T. Nesbit, Utica.
10253	Work of Carpenter Bee (Xylocopa virginica), ...	2	A. P. Lilley, Leroy.
10259	Variegated Cutworm (Peridroma saucia), ...	3	E. S. Mills, New Castle.
10261	Peach Borer Cocoons (Sanninoidea exitiosa), ...	3	R. M. Cummings, Montandon.
10262	Wooly Maple Aphis, ...	3	H. Strickler, Greencastle.
10263	(a) Variegated Cutworm, ... (b) Army Worm (Leucania unipuncta), ...	3	C. F. Armour, Girard.
10266	Black Witch Moth (Erebus odora),	3	R. P. Hoover, Harrisburg.
10267	Sphinx larva, ...	5	Miss A. G. Hill, Driftwood.
10270	Head of Carpenter Ant, ...	5	E. K. Kennedy, Cherry Tree.
10271	Variegated Cutworm, ...	5	G. W. Chase, Altoona.
10272	White Ants (Termes flavites), ...	5	F. Britten, Harrisburg.
10273	Work of Cucumber Root Worm, ..	5	T. K. VanDyke, Camp Hill.
10274	(a) Moth larva, ... (b) Blister Beetle (Epicauta pennsylvanica), ... (c) 12-spotted Cucumber Beetle (Diabrotica 12-punctata), ...	5	D. W. Hazleton, Ambler.
10276	(a) Blister Beetle (Macrobasis unicolor), ...	5	J. F. Dymond, Uniontown.
10279	Bagworm, ...	5	A. Safford, Reading.
10280	Pupa shell of Clear-wing Moth,..	5	D. Preston, Berwyn.
10283	San José Scale (Aspidiotus perniciosus), ...	5	J. F. Smith, Harrisburg.
10284	Ground Beetle (Calosoma scrutator), ...	5	W. S. George, Carlisle.
10290	San José Scale, ...	6	W. Minsker, Dauphin.
10292	Cecropia larvæ (Samia cecropia),..	6	G. W. Martin, Saltsburg.
10293	Tomato and Tobacco Worm (Phlegethontius 5-maculata), ...	6	R. P. Heller, Bethlehem.
10295	Imperial Moth (Eacles imperialis),	6	W. O. Heiser, Kratzerville.
10296	Arctiid Moth larva, ...	6	Mrs. J. Waugh, Washington.
10298	Shot-hole Boring Beetles, ...	6	J. F. Harshberger, Strode's Mills.
10299	Variegated Cutworm, ...	6	D. B. Wilson, Huntingdon.
10300	Oyster-shell Scale, ...	6	W. T. Hildrup, Analomink.
10301	Variegated Cutworm, ...	6	W. Day Wilson, Clarion.
10302	Variegated Cutworm, ...	6	W. P. Tate, Curwensville.
10303	Honey Bees (Apis mellifica), ...	6	L. E. Scherer, Jersey Shore.
10305	Grape Leaf Fly Galls (Cecidomyia viticola), ...	6	E. Householder, Harrisburg.
10306	Dragon Flies, ...	6	G. W. Mumma, Harrisburg.
10310	Scale Insect (Aulacaspis boisduvalii), ...	7	R. Erb, Carlisle.
10313	Lantern Fly Nymph, ...	7	J. C. Engle, Robesonia.
10314	Variegated Cutworms, ...	7	A. Hutton, New Castle.
10315	Bag Worm, ...	7	J. Gries, Essington.
10317	Polyphemus Moth (Telea polyphemus), ...	7	A. B. Miller, Barnesville.
10318	Bagworm, ...	7	F. D. Brinton, West Chester.
10319	(a) Long-horn Beetle (Orthosoma brunneum), ... (b) Variegated Cutworm, ...	7	L. B. Gilmore, Saegerstown.
10320	Orthosoma brunneum, ...	7	M. G. Hill, Rush.
10324	Roach (Ischnoptera pennsylvanica), ...	7	Mrs. A. S. Fasick, Mifflintown.
10325	(a) Regal Moth (Citheronia regalis), ... (b) Luna Moth (Actias luna), ..	8	F. M. Bream, Gettysburg.
10326	Cecropia larva, ...	8	G. J. Heim, Lancaster.
10327	Common caterpillar (Datana integerrima), ...	8	J. Couch, Cannonsburg.
10328	Tree Hopper (Enchenopa binotata).	8	E. R. Mulford, Wellsboro.
10331	Regal Moth, ...	8	J. D. Stauffer, Mechanicsburg.
10333	Work of Striped Cucumber Beetle (Diabrotica vittata), ...	8	F. D. Hall, Equinunk.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10334	Io Moth (Hyperchiria io), ...	8	Helen Morrison, Corydon.
10335	(c) Bristle-tail (Lepisma), ...	9	R. W. Wehrle, Indiana.
10337	Dobson Fly (Corydalis cornuta), ..	9	W. E. Wenner, Kimberton.
10338	(a) Tussock Moth larvæ (Hemerocampa leucostigma), ... (b) Arctiid Moth larvæ, ...	9	J. B. Clifford, McKeesport.
10340	Leaf-hopper Nymphs, ...	9	J. G. Pentz, Greenville.
10341	Cecropia Cocoon, ...	9	E. E. Hess, West Willow.
10348	(a) Granary Weevil (Calandra granaria), ... (b) Saw-toothed Granary Beetle (Silvanus surinamensis), ...	10	D. Hess, Strasburg.
10349	Variegated Cutworm, ...	10	L. J. Rowe, Titusville.
10350	Magnolia Scale (Lecanum sp.), ..	10	J. Hopkins, Juniata.
10351	Dobson Fly, ...	10	E. R. Buzzell, Curwensville.
10352	Milkweed Butterfly Chrysalis, ...	10	J. P. Runk, Newton Hamilton.
10353	Cecropia larva, ...	10	F. E. Chambers, Bristol.
10355	San José Scale, ...	10	S. B. Trostle, New Germantown.
10356	Noctuid Moth larva, ...	12	N. Parker, Munhall.
10357	Stem Borer (Papaipema nitela), ..	12	Mrs. J. E. Hayes, Liberty.
10358	Red-humped Apple Worm (Schizura concinna), ...	12	J. S. Wilkes, Stevensville.
10359	Abbot's Sphinx larva, ...	12	O. L. Fish, Wyalusing.
10360	(a) Aphids, ...	12	Mrs. I. P. Smith, Tyrone.
10364	(a) Lecanium Scale, ... (b) Wasps, ... (c) Hymenoptera, ... (d) Diperta, ...	12	W. H. Teas, Ridgway.
10365	Psocids, ...	12	G. W. Garner, Clover Creek.
10366	Psocids, ...	12	M. C. Kenney, Laceyville.
10367	(a) Oyster-shell Scale, ... (b) Tussock Moth Eggs, ... (c) Psocids, ...	12	D. M. Wertz, Quincy.
10369	(b) Leaf Beetle (Osmoderma scabra), ...	12	L. K. King, Westfield.
10370	Bagworm, ...	12	I. M. Klopp, Wernersville.
10372	Netted-veined Insects (Sialidæ),...	12	L. Taylor, West Chester.
10377	(b) Sphinx larva (Pholus pandorus), ...	12	R. Hill, Harrisburg.
10378	Swallow-tail Butterfly larva (Papilio troilus), ...	13	S. F. Zook, Curryville.
10381	(b) Moth larva, ...	13	S. T. Styer, Danville.
10388	(a) San José Scale, ...	13	S. W. Garr, S. Bethlehem.
10389	Egg shells of Saturniid Moth, ...	13	H. B. Werner, Wernersville.
10390	(a) San José Scale, ...	13	F. S. Franklin, Harrisburg.
10393	Syrphid Fly pupæ, ...	13	W. E. Conaway, Grassflat.
10394	Bagworm, ...	13	R. W. Anderson, Fawn Grove.
10395	Arctiid Moth (Apantesis arge), ..	13	A. B. Miller, Barnesville.
10396	Walking Stick (Diapheromera femorata), ...	13	W. Blevenouer, Hellem.
10398	San José Scale, ...	13	W. Minsker, Dauphin.
10401	Mole Cricket (Gryllotalpa sp.), ...	14	W. Durboro, New Cumberland.
10405	Moth larvæ, ...	14	W. B. Reed, Chambersburg.
10407	Spotted Grape leaf Beetle (Pelidnota punctata), ...	14	Miss E. Robinson, West Chester.
10408	Swallow-tail Butterfly (Papilio polyxenes), ...	14	A. B. Miller, Barnesville.
10409	Psocids, ...	14	G. S. Stahl, Pennsburg.
10410	Southern Tomato Worm (Phlegethontius carolina), ...	14	L. M. Kerlin, Liverpool.
10411	Larvæ of Cucumber-root Worm (Diabrotica sp.), ...	14	J. F. Dymond, Uniontown.
10412	Bagworms, ...	14	M. Geary, Bryn Mawr.
10413	Macrobasis unicolor, ...	14	Mrs. A. Ruger, Wyalusing.
10417	Digger Wasps, ...	14	C. Anderson, Harrisburg.
10420	Long-horn Beetles, ...	15	D. S. Gerhart, Harrisburg.
10421	Psocids, ...	15	R. Knowlton Tiadaghton.
10422	Serpentine Mines of Tineid Moth,	15	A. C. Heacock, Boyertown.
10426	Moth pupæ, ...	15	E. S. Mills, New Castle.
10427	Cecropia Larvæ, ...	15	Clara B. Steele, Tioga.
10428	Cecropia Cocoon, ...	15	H. J. Collins, Volant.
10429	(a) Squash Bug Eggs (Anasa tristis), ... (b) Insect Eggs, ...	15	E. W. Cooper, Oak Lane.
10430	Camel Cricket (Ceuthophilus sp.),.	15	Rev. A. S. Fasick, Mifflintown.
10435	Bagworm, ...	16	J. H. Pecher, Fairfield.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10436	(b) Aphids, ... (c) Cottony Maple Scale (Pulvinaria innumerabilis), ...	16	T. F. Wells, Scranton.
10437	(a) Cicada Killer (Sphecius speciosus), ... (b) Noctuid Moth larva (Acronycta americana), ... (c) Cicada sp., ...	16	G. W. Walter, Dauphin.
10438	Syrphid Fly pupa, ...	16	F. A. Shaw, Albion.
10439	Roach, ...	16	J. W. Eldred, Waynesburg.
10441	Psocids, ...	16	O. D. McHenry, Stillwater.
10442	Luna Moth, ...	16	G. C. Milleisen, Harrisburg.
10444	(a) Stag Beetle (Lucanus dama), (b) Colorado Potato Beetle (Doryphara 10-lineata), ... (c) Honey Bee, ... (e) Short-horned Grasshoppers, ..	16	G. Rupp and A. Hartwick, Harrisburg.
10448	Measuring Worms, ...	17	Gladys A. Beebe, Odin.
10449	Tussock Moth Eggs, ...	17	J. Hirt, Altoona.
10450	Oyster-shell Scale, ...	17	F. Peasley, Emporium.
10451	(a) Prominent Moth Larvæ, ... (b) Wheel Bug (Prionidus cristatus), ...	17	Miss A. Buchman, Doylestown.
10459	Moth pupa, ...	19	Miss L. A. Hickok, Bedford.
10460	(a) Aphids, ...	19	W. A. Harbison, Pittsburg.
10462	Cynip Oak Galls, ...	19	Mr. Livingston, Harrisburg.
10463	Regal Moth larva, ...	19	S. Hartley, Dunkard.
10464	Crane Flies, ...	19	A. B. Miller, Barnesville.
10465	(a) Red-humped Apple Worm... (b) Red-necked Prominent larva (Datana ministra), ...	19	J. M. Schenck, Enid.
10467	Pigeon Tremex (Tremex columba),	19	C. Moore, Wellsboro.
10479	Psocids, ...	20	L. S. Foulk, Schuyler.
10480	Nest of Mud Wasps, ...	20	W. S. Wieland, Bellefonte.
10482	Bagworm, ...	20	J. Haverstick, Oxford.
10483	Psocids, ...	20	W. H. Price, Analomink.
10484	Black Horse Fly (Tabanus atratus), ...	20	P. Brace, Pittston.
10485	(a) Milkweed Butterfly Chrysalid and Larva, ... (b) Luna Moth larva, ...	20	S. E. Firth, Lansing.
10486	Syrphid Fly Pupæ, ...	20	Dr. H. H. Bordner, Shamokin Dam.
10489	Maple Phylloxera Galls, ...	20	J. Shaw, Mansfield.
10490	Work of Chrysomelid Beetle on leaves, ...	20	W. R. Howell, Beavertown.
10493	Bagworm, ...	20	A. Moyer, Lucknow.
10494	(a) Regal Moth, ... (b) Larva of Milkweed Arctiid (Euchaetias egle), ...	20	E. W. Cooper, Oak Lane.
10495	Gray Maple Louse, ...	20	P. Vaughn, Harrisburg.
10496	Psocids, ...	20	N. W. Moyer, Linglestown.
10502	Hummingbird Moth (Hemaris thysbe), ...	21	E. A. Wilcox, Sugar Run.
10503	(b) Short-horned Grasshopper, ...	21	Clara B. Steele, Tioga.
10505	Milkweed Butterfly Larva, ...	21	H. Kerstetter, Liverpool.
10506	Regal Moth larva, ...	21	W. Mumma, Mechanicsburg.
10512	Luna Moth larva, ...	22	G. S. Stahl, Pennsburg.
10513	(a) Bagworm, ... (b) Tussock Moth Eggs, ...	22	Allentown Spinning Co., Allentown.
10516	(b) American Giant Water Bug (Belostoma americanum), ...	23	R. Peris, Harrisburg.
10518	Datana integerrima larvæ, ...	23	E. H. Dunkle, Robesonia.
10519	Parasitic Wasps (Thalessa lunator), ...	23	J. C. Detweiler, Fort Washington.
10520	(a) Saddle-back Larvæ (Sibine stimulea), ... (b) Aphids, ...	23	Miss J. L. Hoopes, Swarthmore.
10521	Bagworm, ...	23	A. H. Witmer, Lampeter.
10523	Regalis larvæ, ...	23	Jennie Wilson, Springtown.
10524	Grape Berry Moth Larvæ, ...	23	Dr. B. L. Ryder, Chambersburg.
10525	(a) San José Scale, ... (b) Scurfy Scale (Chionaspis furfura), ...	23	E. R. Cassaday, Royersford.
10526	Moth (Pantographa limata), ...	24	C. B. Worden, Easton.
10527	(a) Aphids, ... (b) Magnolia Scale (Neolecanium cornlparvum), ...	26	W. H. Teas, Ridgeway.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10531	Dogday Cicada (Cicada tibicen), ..	26	F. Koneig, Harrisburg.
10532	Parasitic Wasps (Pelicinus polyp-turator), ...	26	C. & D. McGuire, Harrisburg.
10534	Insects, ...	26	C. Anderson, Harrisburg.
10536	Work of Morningcloak larvæ (Thanessa antiopa), ...	27	A. W. Brungard, Lock Haven.
10537	(a) Digger Wasps (Sphex ichneu-monea), ... (b) Cone-headed Grasshoppers (Conocephalus sp.), ... (c) Long-horn Grasshopper (Or-chelimum sp.), ... (d) Ant (Formicidæ), ...	27	A. W. Smith, Blairsville.
10538	Terrapin Scale (Eulecanium nigrofasciatum), ...	27	J. Knull, Harrisburg.
10539	Milkweed Butterfly pupæ, ...	27	S. M. Huston, Towanda.
10540	Regal Moth larva, ...	27	L. L. Cheyney, Moylan.
10541	Prominent Moth larva, ...	27	M. H. Groff, Quarryville.
10542	Honey Bees, ...	27	M. L. Main, Grand Valley.
10543	(a) Dogbane Beetle, ... (b) Lightning Beetle, ...	27	T. J. Henry, Apollo.
10544	Work of Chewing Insect, ...	27	B. L. Weaver, Steelton.
10548	(a) Twice-stabbed Lady Beetle (Chilocoris bivulnerus), ... (b) San José Scale, ...	28	Miss P. F. Waterman, Centreville.
10549	Cecropia larvæ, ...	29	Mr. Cameron, Harrisburg.
10552	Yellow Swallow-tail Butterfly larva (Papilio turnus), ...	28	Miss C. Keirn, Hastings.
10553	White Fly (Aleurodes), ...	29	H. Shenfelter, Piketown.
10555	Braconid Parasites, ...	28	C. S. Anderson, Harrisburg.
10559	Predaceous Bug (Coriscus ferus)...	29	W. Durborrow, Harrisburg.
10560	Dogday Cicada, ...	29	J. B. Zinger, Goldsboro.
10563	Rose Leaf-hoppers, ...	29	Hon. F. Wickersham, Steelton.
10564	Bagworms, ...	29	H. C. Barker, Media.
10566	Orthosoma brunneum, ...	29	A. B. Miller, Barnesville.
10567	Long-footed Grape-leaf Beetle (Fidia longipes), ...	29	R. M. Adams, Lancaster.
10568	Morning Cloak Larvæ, ...	29	L. Wagner, Philadelphia.
10569	(a) Tobacco Worm, ... (b) Microgaster Cocoons, ...	29	T. H. Parker, Norristown.
10570	Moth Larvæ (Halisidota caryae), ..	29	Miss. G. A. Beebe, Odin.
10572	Dragon Flies, ...	29	Miss T. McEldery, Transfer.
10573	Oyster-shell Scale, ...	29	F. Peasley, Emporium.
10579	(b) Stink Bug, ...	29	P. K. Hartman, Adamstown.
10582	Collection of Beetles, ...	30	Dr. Raub, Lancaster.
10584	Lecanium Scale, ...	30	Henry Bush, North Point.
10585	(a) Tree Bugs (Brochymena sp.), (b) Stink Bug, ...	30	G. R. R. Warburton, Granville Summit.
10588	(a) Pigeon Tremex, ... (b) Diptera Fly Larvæ, ...	30	Miss C. Salmon, Lock Haven.
10590	San José Scale, ...	30	W. H. Moist, Ryde.
10593	Io Moth larva, ...	31	E. K. Roden, Scranton.
10594	Work of June Beetle, ...	31	P. Z. Supplee, Collingdale.
10595	Bagworms, ...	31	J. Milligan, Wellsville.
10596	(a) Calosoma scrutator, ... (b) Tobacco Worm, ...	31	T. Y. Cooper, Hanover.
10597	Slug Caterpillars, ...	31	Mrs. W. E. Mehaffie, Duncannon.
10600	Spotted Grape Vine Beetle, ...	31	J. Ripley, Harrisburg.
	Invertebrates Not Insects.		
10388	(b) Mites, ...	13	S. W. Garr, South Bethlehem.
10436	(a) Mites, ...	16	T. F. Wells, Scranton.
10444	(d) Spider, ...	16	G. Rupp and A. Hartwick, Harrisburg.
10452	Annulata, ...	17	S. H. Derickson, Annville.
10488	Mites, ...	20	P. Rothwell, Troy.
10503	(a) Millipede, ...	21	Clara B. Steele, Tioga.
10545	Red Mites, ...	27	B. L. Heagy, Palmyra.
10551	Mites, ...	28	Dr. W. C. Baker, Hummelstown.
10561	Mites, ...	29	A. E. Strode, Paxtang.
10579	(a) Millipedes, ...	29	O. K. Hartman, Adamstown.
10587	Spider, ...	30	J. Ripley, Harrisburg.
10601	Crab Spider, ...	31	E. S. Sheaffer, Harrisburg.
	Reptiles and Batrachians.		
10228	Copperhead Snake (Agkistrodon contortrix), ...	1	D. V. Ferguson, Lumber City.
10229	Common Lizard (Sceloporus un-dulatus), ...	1	H. A. Brightbill, Jr., Marsh Run.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10230	Spotted Salamander (Amblystoma punctatum),	1	Blyson Camping Party, Blyson-on-the Clarion.
10231	Common Garter Snake (Thamnophis sirtalis),	1	S. Heisel, Queen.
10232	Common Water Snake (Natrix sipedon),	1	D. H. Bauman, Mance.
10233	Common Water Snake,	1	E. Green, Farrandsville.
10243	Blacksnake (Bascanion constrictor),	1	W. E. Benner, Vicksburg.
10245	House Snake (Lampropeltis doliatus triangulus),	2	J. H. Drill, Cogan House.
10246	(a) Common Garter Snake, (b) Green Frog (Rana clamitans),	2	G. W. Seaman, Wilmore.
10247	(a) Two-lined Salamander (Spelerpes bilineatus), (b) Brown Salamander (Desmognathus fusca),	2	R. E. Schoener, Stouchsburg.
10254	(a) 3 Common Water Snakes, (b) Bull Frog (Rana catesbeana), (c) 2 Green Frogs,	2	G. T. Frey, Emigsville.
10256	Pilot Snake (Callopeltis obsoletus),	3	F. E. Taylor, Mercersburg.
10257	Common Garter Snake,	3	D. H. Bauman, Mance.
10268	Rattlesnake (Crotalus horridus),	5	J. P. Kane, Farrandsville.
10277	Turtle Eggs,	5	W. S. Bienenouer, Hellam.
10286	Pilot Snake,	6	O. N. Shaffer, Hyndman.
10287	Copperhead Snake,	6	W. M. Flanagan, Columbia.
10288	Common Garter Snake,	7	Blyson Camping Party, Blyson-on-the Clarion.
10289	Snapping Turtle (Chelydra serpentina),	6	J. D. Shephard, Wellsboro.
10307	Common Garter Snake,	7	W. Swift, Farrandsville.
10308	Common Garter Snake,	7	W. H. Gretchman, Meyersdale.
10309	3 Striped Water Snakes (Regina leberis),	7	G. W. Gordon, Brownsville.
10321	Sculptured Turtle (Clemmys insculptus),	7	S. Anderson, Harrisburg.
10322	2 House Snakes,	8	E. Neal Delmont.
10323	House Snake,	8	W. A. Shupe, Scottdale.
10332	Pilot Snake,	8	F. E. Taylor, Mercersburg.
10335	(a) Box Tortoise (Terrapene carolina),	9	R. W. Wehrle, Indiana.
10344	Common Garter Snake,	10	C. Kuepp, Farrandsville.
10345	House Snake,	10	J. D. Earon, Farrandsville.
10346	Granite Salamander (Plethodon glutinosus),	10	R. W. Wehrle, Indiana.
10369	(a) House Snake,	12	L. K. King, Westfield.
10373	Box Tortoise,	12	G. H. Nesley, Pottstown.
10375	Box Tortoise,	12	Miss K. Edwards, Harrisburg.
10377	(a) Box Tortoise,	12	R. Hill, Harrisburg.
10380	Copperhead Snake,	13	Smith & Yuckenberg, Indiana.
10381	(a) Common Water Snake,	13	S. T. Styer, Danville.
10382	Rattlesnake,	13	W. Palen, Eatonville.
10384	Common Garter Snake,	14	A. C. Rapp, Kylertown.
10385	Newt (Diemictylus viridescens),	13	G. J. Winmer, Nazareth.
10386	Common Water Snake,	13	Mrs. R. S. Hampton, Lincolnville.
10399	Common Garter Snake,	14	J. E. Peters, Markleton.
10400	Common Water Snake,	14	H. Williams, Connellsville.
10408	House Snake,	14	B. H. Bauman, Mance.
10416	Pilot Snake,	14	J. G. Oberdorf, Mifflinburg.
10419	Common Water Snake,	14	Mrs. R. S. Hampton, Lincolnville.
10434	Copperhead Snake,	16	D. V. Ferguson, Lumber City.
10445	Copperhead Snake,	17	F. J. Nester, New Ringgold.
10446	(a) Common Water Snake, (b) 6 Brown Salamanders,	17	R. W. Wehrle, Indiana.
10447	Common Garter Snake,	17	Dr. H. B. Meredith, Danville.
10454	Leather-back Turtle (Aspidonectes spinifer),	19	J. Custer, Stoyesville.
10455	Common Garter Snake,	19	A. F. Smith, Blairsville.
10456	Rattle Snake,	19	Alonza A. Phillips, Farrandsville.
10457	House Snake,	19	A. O. Apker, Penfield.
10458	Hellbender (Cryptobranchus alleganiensis),	19	R. W. Wehrle, Indiana.
10473	Common Garter Snake,	20	G. H. Rea, Reynoldsville.
10474	House Snake,	20	C. Breed, Tioga.
10475	2 Common Water Snakes,	20	A. W. Smith, Blairsville.
10476	Common Water Snake,	20	Miss J. Relehan, Lock Haven.

SPECIMENS RECEIVED DURING AUGUST, 1907—Concluded.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10477	(a) Blacksnake, (b) 5 Rattlesnakes,	20	A. H. Stevens, Enid.
10478	2 Copperhead Snakes,	20	H. E. Smith and H. G. Yuckenberg, Indiana.
10497	2 Cave Salamanders (Spelerpes longicauda),	20	Dr. J. M. Keath, Schaefferstown.
10498	Red-bellied Snake (Storeria occipitomaculata),	21	A. C. Rapp, Kylertown.
10499	Grass Snake (Liopeltis vernalis),	21	C. B. Steele, Tioga.
10501	Blacksnake,	21	E. G. Vought, Elysburg.
10507	(a) Box Tortoise, (b) 2 Green Frogs,	22	R. W. Wehrle, Indiana.
10508	Grass Snake,	22	D. H. Bauman, Mance.
10510	Common Garter Snake,	22	R. Kuepp, Farrandsville.
10511	Cave Salamander,	22	W. Don Morton, McConnellsburg.
10514	Pilot Snake,	23	R. W. Wehrle, Indiana.
10515	Rattlesnake,	23	A. P. Quick, Milford.
10516	(a) Common Water Snake,	23	R. Peris, Harrisburg.
10529	Common Water Snake,	26	R. D. Ulmer, Cogan House.
10530	(a) Blue-tailed Skink (Eumeces fasciatus), (b) Common Lizard,	26	J. A. Shuey, Penbrook.
10535	Pilot Snake,	26	F. G. Couch, Andersonburg.
10546	(a) Common Water Snake, (b) Blowing Viper (Heterodon platirhinos), (c) Painted Turtle (Chrysemys picta),	28	G. A. Palmer, Warfordsburg.
10547	(a) Common Water Snake, (b) 2 Common Garter Snakes, (c) 4 Leopard Frogs (Rana pipiens), (d) Red Salamander (Spelerpes ruber,	28	J. Couch, Canonsburg.
10554	Eggs of Blacksnake,	28	J. F. Reisinger, Ickesburg.
10556	Blowing Viper,	29	D. H. Bauman, Mance.
10557	Sculptured Turtle,	29	G. Baker, Noxen.
10558	Common Garter Snake,	29	D. H. Uncapher, Ebensburg.
10578	Blacksnake,	29	T. Oxford, Jr., Bangor.
10583	Red-bellied Snake,	30	Miss F. M. Benedict, Girard.
10589	Common Water Snake,	30	F. M. Brubaker, Johnstown.
10598	Eggs of Box Tortoise,	31	M. P. Hartzell, Lebanon.
10604	House Snake,	31	W. Parks, Linglestown.
	Birds and Mammals.		
10330	White-footed Mouse (Peromyscus leucopus),	8	J. W. Jacobs, Waynesburg.
10335	(b) Brown Bat (Vespertilio fuscus),	9	R. W. Wehrle, Indiana.
10336	Catbird (Galeoscoptes carolinensis),	9	Mrs. J. Waugh, Washington.
10374	Brown Bat,	12	Miss P. Wise, Harrisburg.
10387	Brown Bat,	13	Miss H. Gise, Harrisburg.
10425	Night Hawk (Chordeiles virginianus),	15	E. F. Eisely, Harrisburg.
10483	Great-horned Owl (Bubo virginianus),	16	N. M. Naginey, Milroy.
10507	(c) Marsh Hawk (Circus hudsonius),	22	R. W. Wehrle, Indiana.
10509	Meadow Mouse (Microtus pennsylvanicus),	22	W. Angus, Stoddartsville.
10528	Sharp-shinned Hawk (Accipiter velox),	26	J. Schraedley, Middletown.
10577	(a) Sharp-shinned Hawk, (b) Marsh Hawk,	29	W. G. Judson, Meshoppen.
10592	Sparrow Hawk (Falco sparverius),	31	W. G. Judson, Meshoppen.

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THE

ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

VOL. V, No. 8.

SUBJECT: The Lizards of Pennsylvania.

December 1, 1907.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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Plate XXXII. Ground Lizard (*Leiolopisma laterale* Say.) Dorsal, ventral and side views. Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, published in his "Annual Report for 1906."

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Fig. 27. Ground Lizard (*Leiolopisma laterale* Say.) Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

Fig. 28. Common Lizard (*Sceloporus undulatus* Daud.) Kindly loaned by Prof. S. R. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

PREFACE.

The title of this publication as "The First Report on Pennsylvanian Lizards" indicates the possibility of a second or subsequent report. Studies are continuously being made in the office of the Economic Zoologist to obtain additional important facts concerning the fauna of our State. There is scarcely a creature found, native or undomesticated, within the borders of this State of which as much is known concerning it as should be known in order to say with certainty that it is beneficial or obnoxious and to show how to suppress it if it be objectionable, or to preserve it and increase its race if it be beneficial.

We need notes or reports of observations concerning the appearance of such creatures, their habits, haunts, food, methods and dates of reproduction, care of eggs and young, enemies, abundance, and other points that are worthy of entering into the second and more complete publication upon this subject. We, therefore, invite all observers to send us definite records of their observations, in order that we may be able to add them to those made by others and ourselves, and thus prepare a more useful publication than would be possible were it not for the benefits of co-operation in making observations and records.

We also need many more specimens collected at different places and at different times of the year, and would, therefore, urge readers to make a special effort to collect such specimens and send them to us, by mail or express, at our expense. Specimens should be killed at once, by shooting with very fine shot, or by sticks, snares or other means, and sent immediately, by mail or express, to the Economic Zoologist. They will be acknowledged and identified, questions will be answered concerning them, and in later publications credit will be given to persons contributing them. The next publication upon this subject by this office will be sent free first to those persons contributing notes of observations or specimens, and in order to be sure to receive the second report, it is well for persons who are especially desirous of obtaining it, to make a particular effort during the summer to collect and send us specimens or recorded observations. such as are desired.

All communications and specimens should be addressed to

H. A. SURFACE, ECONOMIC ZOOLOGIST,

Harrisburg, Pa.

FIRST REPORT ON THE LIZARDS OF PENNSYLVANIA.

LACERTILIA. THE LIZARDS.

The Lizards are Reptiles that are not covered with shields nor plates, but the body is usually protected by overlapping scales; the bones of the upper and lower jaws are more closely united than in the serpents, and the mouth is consequently not dilatable. The quadrate bone, which moves freely in the serpents and permits the mouth to open to a tremendous extent in those reptiles, is present in the Lizard but is joined to the skull and does not perform the same functions as in the serpents. The jaws of Lizards are always provided with teeth, but never with fangs. The limbs are four in number, distinct, sometime rudimentary and hidden by the skin. The tail is usually long and is most cases is very brittle and separates readily from the body by a slight blow. This serves an important purpose in permitting its owners to escape. It has often happened that a bird, serpent, or some other enemy has attempted to catch a Lizard and has been greatly surprised to find the tail remain wriggling violently while the body of the animal quietly and very speedily slips away with safety. The tail is then renewed or again grows, but if there is an injury to the bone at the place of separation it often results in two or more tails developing and sometimes having the appearance of toes on a foot, thus resembling a fifth foot. It not unfrequently happens that persons attempting to pick up Lizards by the tail find in their hand only the wriggling appendage, after the body has disappeared to a place of safety.

The Lizards are mostly tropical and subtropical in their distribution, and only five species are known with certainty to occur within the borders of the State of Pennsylvania. Some of these are so rare in this State that we have found no opportunity to study their habits, and specimens are desired. None are common in this State, as this is very near their northern limit of range, where they naturally are more rare.

Lizards live mostly in very hot and dry places and in such places as Salamanders would not frequent. They avoid to a great extent water and swamps, although they will plunge into water and swim to escape a pursuer.

A common error is made in referring to the Salamanders as Lizards. The Salamander is not a Lizard, and in fact does not be-

long to the class of reptiles but to the amphibians. They are more closely related to the frogs than to the Lizards. [See Plate 1.] Salamanders always lay eggs in water or very damp places, and the young are tadpoles, breathing at first by means of gills, and later transforming into animals of the same form and species as their parents. No Salamanders are in any way dangerous or poisonous, and the common fear and superstition concerning these animals is entirely unfounded. Their skin is always smooth, without scales, and cool, moist and slimy. They should not be mistaken for a Lizard. These Amphibians will be discussed in a separate Report which we are now preparing to issue as a Monthly Bulletin of the Division of Zoology some time in 1908.

The Lizards lay eggs, or bear living young, away from the water and spend no portion of their life whatever in the water, and do not undergo metamorphosis as do the Salamanders. All of the species of Lizards found in Pennsylvania reproduce by laying eggs and all are readily recognized by the presence of small scales covering both the upper and under sides of the body, the four legs present, and the long tail.

It is too commonly and wrongly believed that a Lizard is venomous or poisonous and can inflict injury. These creatures are entirely harmless to mankind, and have no power to do him injury, although they are decidedly beneficial in their economic relations in feeding almost entirely upon insects. A detailed discussion of their food will be found under each respective species which we have studied in detail. More specimens are desired to aid in these investigations.

LIZARDS REPORTED IN THE HUMAN STOMACH.

Another common error concerning the Lizard is that it can live in the human stomach and is sometimes swallowed with water and causes serious stomach trouble. Quack doctors make use of this belief to impose upon their patients, and enrich themselves. No reputable physician and no zoologist will accept as true the statement that any Lizard or Salamander, Serpent or other Reptile or Amphibian can live in the human stomach for ten minutes. There has been considerable discussion of this subject, but it is well established that many patients who have been suffering from stomach trouble, such as severe indigestion, cancer of the stomach or some other malady, have found this organ so intimately connected with the brain as to cause mental delusions, resulting in the belief in the internal Lizard or Salamander.

There has been a great deal published in the newspapers concerning Lizards living in the human stomach. We have had considerable

correspondence upon this subject. One of our most interested correspondents is Dr. D. J. Doran, of Gloucester City, N. J. A letter from him and our reply are as follows:

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I see by published accounts your opinion that Lizards were never swallowed by people, and as I have given that particular subject much study, I take the liberty of writing to you.

All writers that I have seen, on parasites, agree with you, and I also have a letter from the late Professor E. D. Cope, the famous Naturalist of the Smithsonian Institute at Washington, D. C., and from physicians of all schools saying the same as you, in substance, that Lizards, even if taken into the stomach as "eggs" on food, or from the surface of a shady spring, would soon be used up by the heat of the stomach, being reptiles, and in the process of digestion all traces of Mr. Lizard ends. Scientists who have read up on Parasites and pose as authorities continue to deny this, as in your case, but nearly everyday newspapers publish a lizard story, and no good denial is ever made. Only the stereotyped denial handed down from ages. So it might be asked, "Why don't it settle these lizard stories, like the medical myths that are being wiped out every day, one by one?"

There still remain persons who are slow to accept your views as final, when we find a Doctor K., a worm doctor, with colored pictures displayed in his window, showing Mrs. So and So, the lizard alleged to be removed, the spring, etc. He issues descriptive literature, testimonials about cases of lizards being swallowed and removed by his stuff, and has numerous specimens in stock as well as cartloads of tapeworms. I cite him to show how the public continues to believe that lizards do happen to be an accidental parasite of the digestive apparatus. I took up this subject some years ago when a man showed me a lizard, such as is seen on fences, and I identified it, showing it was not a newt. He claims it was in his stomach three years and came up by vomiting, and he still insists it is true. His lizard could not have come from a "spring" as here only Newts are found so if in his stomach the "egg" may have been eaten on vegetables that were attacked by some fence lizard, as does happen in the case of other parasites. As I don't know the father of the tapeworm, I am still in doubt about the lizard, and have no opinion to state whether lizards could live in a man's stomach or not; so if you continue this subject by writing a magazine article relating thereto, or any matter published, I would be pleased to know it, as literature on this subject is very interesting to me.

I remain yours respectfully,

D. J. DORAN.

Reply:

"My Dear Sir: I thank you for your letter calling my attention to the widely spread belief that, nothwithstanding what most physicians and all zoologists may have to say, it may nevertheless be true that such creatures as lizards do live in the human stomach. I note with particular interest that you say you have a letter from the late Prof. E. D. Cope, stating that lizards, after taken into the stomach, would soon be killed and digested, and all traces of the lizard would end. This is correct, but I should certainly thank you most cordially if you would be willing to loan me that letter, in order that I could copy it at once and return it to you. I should be willing to use it in my forthcoming Bulletin on this subject and give you full credit for the same.

I would call your attention to the fact that such creatures as lizards and salamanders are not parasites, and are not adapted to internal parasitic life that other worms endure. They must breathe free air or be suffocated, as could be observed by putting one in a bottle and corking it tightly.

The person who poses as a "worm doctor," with colored pictures and specimens whose origin may by no means be authentic, is of course, a quack, and the very fact that he makes a display such as you mention shows that he is a quack and impostor and cares nothing about disseminating the truth, but advances only his own interests in obtaining money. There is no doubt about the existence of the tapeworm as an internal parasite, and the comparative ease with which it can be remedied. Consequently, it may be possible for such a person to obtain specimens of these true parasites and catch lizards from the woods and add them to his collection in order to make it more impressive. As long as the public is so uneducated as to accept what such quacks have to offer rather than to accept the statements of such professional naturalists as Prof. E. D. Cope and Dr. G. Brown Goode, they may abide by the results of their own ignorance, as I and other students of such subjects care more for the opinion of Prof. Cope and Dr. Goode when definitely expressed than for that of all quacks on the earth.

When the man showed you the fence lizard, which he claimed was in his stomach three years and was ejected, you should have learned the detailed facts of the case. It may have been a case of hysteria, mild insanity, opium or other "delusion." The mere exhibition of a specimen and the statement of that kind does not make it true. This I have proven conclusively in recent correspondence on this subject which I could submit to you if I had time.

The fact is, as you say, that this species of lizard does not live in the water, as does the newt, and consequently could not have

been swallowed by drinking water; and also could not have been eaten as an egg on a vegetable. Positively, I do not believe that any human stomach ever contained a live lizard, and if any other such creature should find its way into the human stomach it could not exist there more than a few minutes at the most.

The tapeworm does not transform into some other higher creature but produces eggs from which develop small worms encysted in delicate membrane, which may not be larger than a pea, and to complete their development must be swallowed with uncooked or "rare" meat which they infest. There is no transformation into a large creature like a winged insect or lizard, or anything of that kind.

I do not think it proper to apply the word "parasite" to a lizard or salamander, under any circumstances, as they are entirely different from the true internal parasites, and if they could be imagined as living in the human stomach, they would be no more parasites than are squirrels which live inside of trees.

I note the enclosed slip in which you state that Jeffrey's in his work on "Parasites" says, "The only reason why amphibians, frogs and lizards can not permanently live in the human body is the moisture and heat which is at least 80 degrees Fahr., which no specimen of amphibian can resist from two to four hours." I beg to say that this is entirely untrue. The real reason why such creatures could not live in the human body are (1) the absence of atmosphere or any means of respiration, which suffocates them at once, and (2) the extreme severity of the gastric juices, would kill them and they would be digested. Such a creature would have no more prolonged existence in the human stomach than would a piece of beefstake. Also Mr. Jeffrey's is wrong in stating that the temperature of the human body is "at least 80 degrees Fahr." We know that it is almost constantly 18 degrees more than that, and we also know that it is not infrequent to see frogs and salamanders in the open, where the temperature of the atmosphere surrounding them is more than 80 degrees or even 98 degrees Fahr., and lizards themselves often lie on hot exposed stones at a temperature of over 100 degrees. Moisture and such mild temperature as 80 degrees would be congenial to the living frogs, salamanders and lizards, and I am surprised that any person presuming to be an author should make such a statement as the above, which you have kindly copied and sent to me.

What I shall publish upon this subject will be in my Monthly Bulletin, which is now in the course of preparation, and I shall be pleased to have you receive a copy of the same.

Very truly yours,
(Signed)
H. A. SURFACE, ECONOMIC ZOOLOGIST.

Mr. Doran was in correspondence with two of the greatest authorities in America upon this subject in 1896, and kindly sent us the letters from Prof. E. D. Cope and Dr. G. Brown Goode, which give greater emphasis to the statement here made. These are worthy of publication and preservation and are as follows:

Smithsonian Institution,
Office of Assistant Secretary,
In charge of U. S. National Museum.

S. P. Langley, Secretary,
G. Brown Goode, Assistant Secretary.

Washington,

Mr. D. J. Doran, Gloucester City, New Jersey.

Dear Sir: In reply to your letter of June 8, I can only say that it is more than improbable, if not altogether impossible, that the lizard lived in the man's stomach, as he claims, nor is it at all probable that he vomited it up. Stories of this kind are frequently told, and the institution is constantly receiving them. In the present instance it may not be an intentional mis-statement on the part of the young man to whom you refer. It may simply be a case of self-delusion.

Yours respectfully,
(Signed)
G. BROWN GOODE,
Assistant Secretary, Smithsonian Institution, in charge U. S. National Museum.

2102 Pine St., Phila., Pa.

Dr. D. J. Doran,

Dear Sir: The man who told you that he had a live lizard in his stomach for three years probably lied. All the newspaper stories of a similar nature are also inventions of those in charge of the paper, or copies of some other journals that have also lied. The physicians are right on this point, that it is impossible for lizards, etc., to live in a human stomach. If a reptilian egg should by chance be hatched in a man's stomach, the animal would soon die. As to your last question, lizards are not parasites, so that you will not find any reference to them in any work on parasites.

Very truly yours,
(Signed) E. D. COPE.

We have persistently made effort during recent years to follow up by correspondence any reports in the newspapers purporting to give accounts of lizards or similar creatures in the human stomach. In

no case could we find satisfactory evidence of the truth of such report. As the result of our correspondence a few interesting instances have come to light. For example, in 1905 there was published extensively a report of a lizard having been voided by a patient, near Marietta, Pa. The name of the Doctor was given, as well as the name of the patient, and as the evidence was circumstantial and apparently reliable we wrote to the physician and received a reply that there was a basis for such report, but that in his opinion the material consisted of fragments of a tapeworm instead of a lizard. This of course is quite possible.

In 1907 there appeared several published reports concerning an actress dying in a Hospital in Omaha, Nebraska, and lizards crawling from her mouth at the time of her death. We wrote to the Mayor of Omaha, concerning this and he replied that while such a person had recently died there, the story concerning the presence of lizards, or anything of that kind, was entirely false.

We also received a report of two "lizards" having been vomited by a woman in Berks county and that the specimens were preserved in spirits and we could examine them ourselves. We sent for the specimens and were fortunate enough to procure the two specimens in a bottle of alcohol. Upon examination they were found to be Cave Salamanders, (*Spelerpes longicauda*), such as live commonly beneath the bark of fallen logs in this State. In their stomachs were found Wood Flies, which showed that within a few hours previous to their death they had been living in their native haunts in the woods, and had been feeding upon flies flying around the logs. Thus they could not have been in the stomach of the woman for two years, as was stated. The physician, who knew the woman quite well, was at first inclined to believe her story, but wrote us later that he believed it to be a case of hysteria or extreme nervousness, with a possibility of mental derangement, and the women may have contrived to collect the salamanders from the woods and during a fit of extreme nausea may have produced them to convince other persons in accepting her belief as to the cause of her troubles. While one of her relatives yet maintains the theory that the creatures had been in her stomach, the evidence was such that it can not be accepted.

THE FOOD OF PENNSYLVANIA LIZARDS.

As far as we can learn, this is the first time that a detailed study has been made of the food of Lizards and Turtles, *and consequently there must be much interest attached to the definite statements here made. Some general remarks have occasionally been published concerning the food of these creatures, but it is evident that definite careful dissections and a specific study of the subject have been almost neglected until the present time. As all specimens and contents of stomachs are preserved permanently in the office of the Economic Zoologist, it will not be a difficult matter for any person to verify these studies or look over them further at any time in the future. The records and specimens of this office are open to the free use of investigators who may wish to use this material for further studies in seeking the truth.

It is to be noted that this publication is offered as the First Report of the Lizards of Pennsylvania. This indicates the contemplation of the publication of subsequent reports, from time to time, as sufficient material accumulates in our hands to justify the publication of additional important facts. This implies the fact that we desire more specimens of Pennsylvanian Lizards and Turtles in order to advance these studies to points of certainty. In sending this publication to our contributors in various parts of the State we are only returning to them our part in the interest of their own labors and assistance. We invite further help along these lines for the sake of aiding in ascertaining the truth concerning the creatures too often dispised and neglected, but which evidently have an important sphere in the grand Scheme of Nature.

Attention should be called to the fact that the creatures commonly called "Lizards" are really Salamanders and not Lizards. Salamanders are Amphibians or Batrachians and belong to the same general Class or same Branch of animals as the frogs. They live in the water or in damp places, and have moist or slimy skin, lay eggs in water or damp terrestrial places from which hatch young that have gills, resemble tadpoles, and undergo metamorphosis similar to that of frogs and toads. Lizards are indeed Reptiles and not Amphibians or Batrachians. They have all the attributes of reptiles; they are covered with scales, live in warm dry places,—never in water, and some lay eggs from which hatch young that are not tadpoles, but are similar to their parents, while others bear living young.

Although only two species of Lizards were sufficiently common in this State to enable us to make a study of their stomach contents, we have collected enough specimens of the Swift to give us

*Our Report on Pa. Turtles is to be issued soon as one of our monthly Bulletins.—H. A. S.

fairly safe conclusions as to food and to show it is of decidedly economic value in aiding to suppress snails and insects of objectionable kinds.

Of the specimens of Swifts examined only twenty-five contained food, but this number is far more than has before been definitely examined and recorded. Therefore, even in this limited study certain new points are to be brought forth. Of these Pennsylvanian Lizards twenty-five were the species known as the "Swift" and one was the "Blue-tailed Lizard." The differences of species are given in descriptions elsewhere in this Bulletin.

It is to be noted that not one Lizard was found with any vegetation or vegetable material in its stomach, and we are thus justified in the conclusion that Lizards cannot injure vegetation and are therefore safe in orchards and woods, as far as concerns any probability of their injury to trees or other plants. Three Lizards had eaten snails, and in so doing were rendering an important service to mankind in aiding to destroy the pests of the garden. One had swallowed a species of crustacean, such as is often found under boards in damp places, and known as the sow bug or pill bug, and five had eaten spiders. All the Lizards examined had partaken of insect food, showing that they are almost wholly insectivorous in their feeding habits. In this connection it is important to note that they did not feed on insects belonging to the lower entomological orders. These insects are generally the aquatic species, or those living in or near the water. In this fact may be found the explanation as to why they were not taken as food of these reptiles which live almost wholly in very dry situations. Only one aquatic insect was found eaten by a Lizard, and as this was an adult or winged Stone Fly it may have flown to a dry region inhabited by a Lizard rather than the latter coming to the low or damp grounds to find food.

It is interesting and important to note that six specimens of Lizards, or about one-fourth of the total number examined, were found to have eaten grasshoppers. These were nearly all the so-called Short-horned species (Acrididae), and are the kinds that are quite destructive to vegetation. It is important to note that the Long-horned Grasshoppers, of the family Locustidae, were not eaten by Lizards. An explanation of what may appear to be a choice in favor of the Short-horned species as against the Long-horned species is to be found in the fact that in this State the grasshoppers belonging to the latter family live mostly in damp regions, such as are avoided by the Lizards, while the Acrididae or Short-horned grasshoppers are found in fair abundance even on the dry and rocky mountain sides which the Lizard frequents. Thus

the place of living or haunt would determine not only the food which the creature obtained, but also the natural enemies which it would meet.

Two Lizards had eaten crickets, but the fact that so few crickets were taken, while so many Short-horned grasshoppers were devoured, would indicate the Lizard as a daytime feeder, while it is known that crickets would be available for their enemies by night rather than by day, when they are more active and come forth from their retreats. It is remarkable to note that of the very large order of Hemiptera or Bugs only three specimens had been eaten by Lizards. Two Lizards contained insects which upon careful examination proved unquestionably to be a kind that are commonly called Stink Bugs, belonging to the family Pentatomidae. This indicates that the Lizards do not take their food by smell, and may make but very little use of the senses of smell and of taste. In destroying these objectionable creatures the Lizards are rendering an important service to mankind, especiallly in the preservation of certain plants.

Note that the aquatic Bugs were entirely ignored as food by Lizards, and this again indicates the important relationship of habitat (haunt) or place of living in regard to the kind of food that is available and is taken. In this regard strict comparison and contrast should be made with the study of the food of the Painted Turtle, to be discussed in a later Bulletin.

While we must chronicle the fact that only one Lizard had eaten an adult or winged moth, seven had feasted upon moth larvae or caterpillars, commonly called "worms." In the destruction of these pests Lizards proved their beneficial quality, especially as shown in the fact that two of the larvae were identified as cutworms. It is known that the Lizard is a creature which becomes quiet or dormant when the weather is cold, and also after night when the air is more chilly, and becomes more active in the day time, especially when the sun is hot. It is evident that these habits have an important relationship to its food, and the moths, being almost wholly nocturnal creatures, would not be expected to contribute extensively to the menu of such a creature as the Lizard. The night-flying insects were not found extensively eaten by these animals. The fact that twenty-one per cent. of all the stomachs of lizards contained caterpillars is enough to justify the suggestion of placing these harmless little animals in orchards to aid in preserving the trees.

While the climate of Pennsylvania is not adapted to the great multiplication of Lizards and it is the opinion of the writer that the artificial propagation of Lizards as natural enemies of insects would not be practical in this State, yet steps toward this might be taken

with satisfactory results further South. We have heard of a fruit grower in Georgia who paid the colored boys one cent each for living Lizards, and upon turning these creatures into his orchard, placing one on each tree, he found that they not only aided in suppressing the insects and other pests of the trees and fruits, but gave particularly valuable service in preventing tresspassing upon his property on the part of ignorant and superstitious persons who regarded the Lizards as capable of inflicting great bodily injury, and who would not therefore think of entering his orchard under any circumstances.

It is rather surprising to note that only one specimen of Lizard was found to contain flies, or insects belonging to the order Diptera. This may in part be due to the readiness or quickness by which these particular insects are digested, and in part to vigilance and speed of the flies in watching for and escaping their enemies.

Beetles form the chief bulk of the diet of Lizards as fifteen, or about sixty per cent. of all, were found to have eaten insects belonging to this entomological order. It is noteworthy that we found no ground beetles in the stomachs of Lizards, and owing to the absence of these, and other beneficial insects in general, we must declare that Lizards are not justly liable to the charge of exerting an objectionable influence on the property of mankind by the destruction of his insect friends. It is indeed remarkable how few insect friends or beneficial insects were found eaten by members of this group of reptilian life, which are almost wholly insectivorous in the feeding habits.

Three Lizards ate click beetles, which are the adult or mature forms of wireworms, which are so destructive to cultivated plants of various kinds. As there is no satisfactory remedy for wireworms, we have very important justification in learning and preserving their natural enemies.

Three Lizards were found to have eaten Ichneumon flies, which are parasites in insects of various kinds, and thus are generally to be called beneficial, but when in turn they are parasites upon beneficial insects they become obnoxious from an economic standpoint, and their enemies would be beneficial in results. However, it must be recognized that in the destruction of the Ichneumon flies, and perhaps also of spiders, the Lizards are overstepping the strict bounds of economically beneficial creatures, as set forth from the rather selfish standpoint of mankind.

It is, of course, to be expected that vertebrates would form almost no item in the food of these Lizards, since they are so very small, and in the absence of vertebrate animals from their stomachs they verify the justifiable belief that in this State they feed upon no creatures higher than those belonging to the insect world.

In literature, and by correspondence, occasional reports have reached us concerning lizards in warmer climates having eaten Vertebrates such as other lizards, serpents, mice or even small birds, but it must be remembered that such reports come from portions of the country where lizards reach a very much greater size than they attain in the State of Pennsylvania. While such feats may be possible for the larger individuals, it is scarcely to be expected for those that are no larger than the specimens that we have seen representing the lizard of the latitude of Pennsylvania.

In referring to the variations of the size of lizards according to the latitude, it appears worth while to put into publication, and thus on record, the suggestion that specimens of the same species of lizards and perhaps of other reptiles, remain much smaller in size than do the representatives of the same species from the southern or warmer portion of the country. Measurements of the specimens which we have seen in the northern regions compared with the measurements recorded for the southern specimens of the same kind give proof of this. The decrease of size in reptiles of the same species as we proceed northward is only in harmony with the natural laws and conditions observed in other organisms. In going northward even plants become greatly stunted. There is no reason why the decrease in size of reptiles could not be attributed to the natural working of the laws of Nature, limiting their growth and the amount of heat and food to be obtained as they extend into the northern regions, where the warm season is less prolonged, and the amount of heat during the summer is considerably reduced, and where the food becomes more scarce. These factors certainly would tend toward the production of smaller individuals.

Of course, with all reptiles, as with fishes, the kind of food is liable to change with the size of the creature, and thus there may be a variation in economic influence due to the size, which would in turn be due to the latitude and temperature.

Analytic Key to the Families of Pennsylvanian Lizards.

A. Tongue covered with scale-like points (papillae).

B. Tongue long, free or not bound down at front and side, with a very shallow and but slight notch in front; bony plates underlying the scales; Family I. Scincidae. The Skinks.

BB. Tongue shorter, free in front, but bound down at the sides; a deep notch and two long points in front; no bony plates under the scales. Family II. Teiidae. The Striped Lizards,

AA. Tongue covered with very close-set, small, soft points (papillae) like fine velvet, thick, only slightly free around the edges, and but slightly notched in front. Family III. Iguanidae. The Iguanas.

FAMILY I. SCINCIDAE. THE SKINKS.

Different species of Skinks vary in form from short and stout to long and worm-like. The tongue is thin, black, moderately long, free, slightly notched in front and covered with overlapping scale-like papillae or points. The head is covered with regular symmetrical shields or plates. The scales are smooth and supported by bony plates beneath them.

About sixty genera are known, including about two hundred species only thereof which are known to occur in Pennsylvania. These are to be distinguished by the following Analytic Key:

Key to the Species of Pennsylvania Skinks.

A. Palate with teeth, with two slits, one from each nostril; ear large, front edge toothed. Genus Eumeces.

B. Body with five yellowish streaks; scales in twenty-eight to thirty-four rows along the body. 1. *Eumeces fasciatus.* The Five-lined Skink.

BB. With four yellow stripes; scales in twenty-four rows around the body. 2. *Eumeces anthracinus.* The Black Skink.

AA. Palate toothless, cleft by a single slit in the middle; ear very large, circular. Leiolopisma. 3. *Leiolopisma laterale* (Say.). The Ground Lizard.

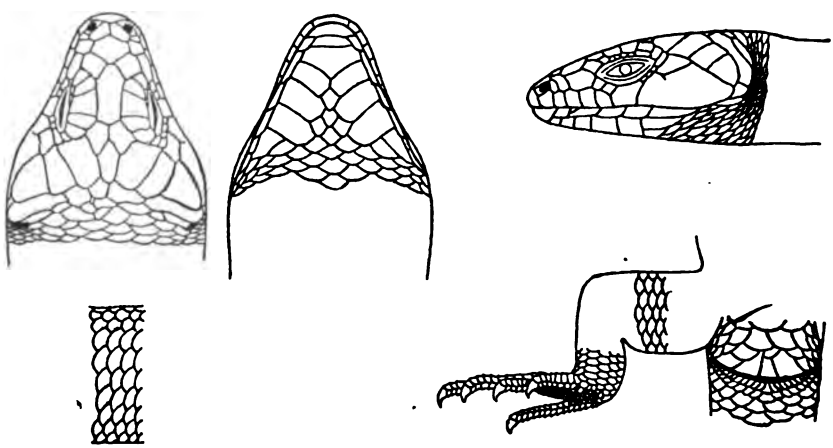

Fig. 26. Blue-tailed Lizard (*Eumeces fasciatus* Linn.). Dorsal, ventral and lateral views of head; and arrangement of scales on side of body and on hind leg and base of tail, ventral view. Kindly loaned by Prof. S. R. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

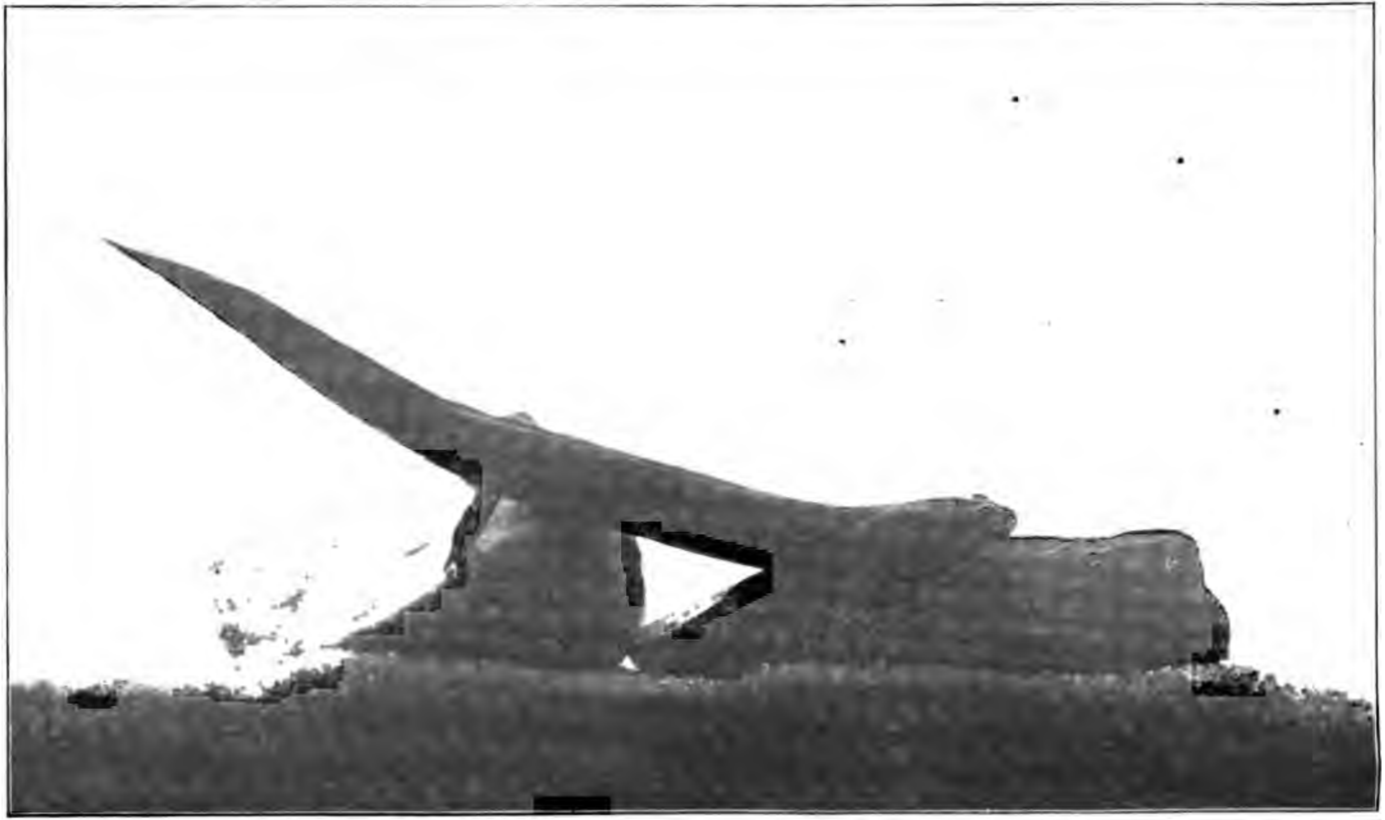

Plate XXX. Red Triton (*Spelerpes ruber* Daud.). Adult, nearly nat. size. Photographed from life, under water, by Dr. R. W. Shufeldt. To Illustrate a Salamander.

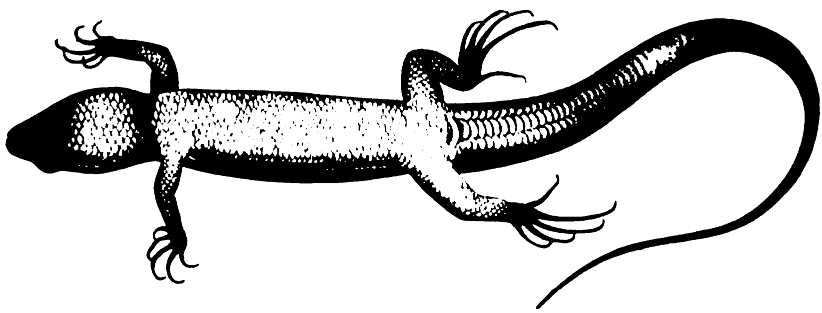

Plate XXXI. Blue-tailed Lizard (*Eumeces fasciatus* Linn.). Dorsal and ventral views. Kindly loaned by Prof. S. R. Morse, Curator of New Jersey State Museum, published in his "Annual Report for 1906."

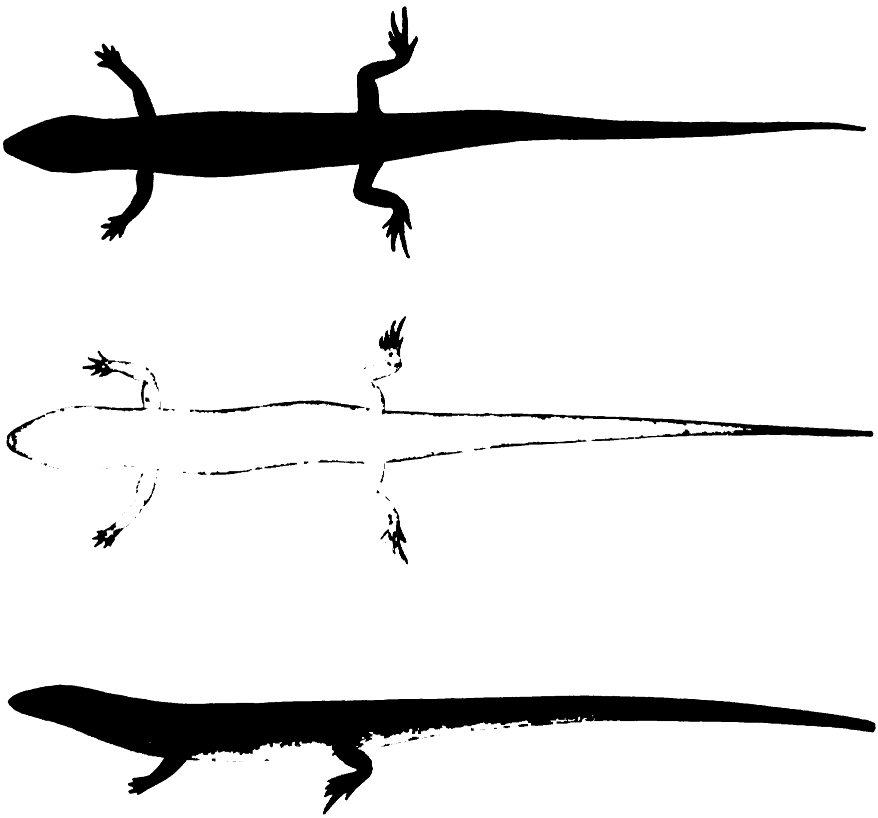

Plate XXXII. Ground Lizard (*Leiolopisma laterale* Say). Dorsal, ventral and side views. Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, published in his "Annual Report for 1906."

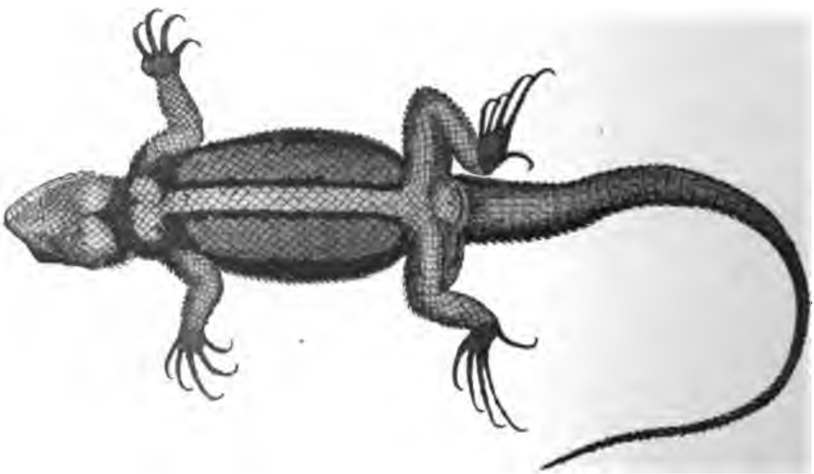

Plate XXXIII. Common Lizard (*Sceloporus undulatus* Daud.). Dorsal and ventral views. Kindly loaned by the N. J. State Museum, published "in Annual Report for 1906."

No. 1. *Eumeces fasciatus* (Linnaeus). **The Five-lined Skink.**

This little Lizard is known by the various names of the Blue-tailed Lizard, Blue-tailed Skink, Five-lined Lizard, Five-lined Skink, Red-headed Lizard, Red-headed Skink, Striped Lizard, Striped Skink, "Scorpion" and Blue Skink. It is probably due to its remarkable quickness of movement that the expression has originated, "As quick as a blue streak." The proper expression shoud doubtless be, "As quick as a bue skink." It is, of course, wrongly called the "Scorpion," as this term should apply only to spider-like crustaceans or invertebrates.

The Five-lined Skink is found in the United States from Massachusetts and Northern Indiana to the Rocky Mountain region inclusive, and southward over the Eastern and Central States.

What few specimens have been received by us have been from widely different parts, showing the possibility of its being found over practically the whole State of Pennsylvania; although it is rare; and where it occurs it is often not seen excepting by persons making a special effort to search for it. Our collections of this species are as follows:

Centre county,	Surface, H. A.,	...	State College.
Clarion county,	Heffner, H.,	5.8	Leeper.
Dauphin county,	Shuey, J. A.,	(a) 3 (b) 2.3	Penbrook.
Montour county,	West, Mrs. G. P.,	...	Danville.
St. Tammany Co., La.,	Geist, Karl,	5.6	Covington, La.
Mecklenburg Co., Va.,	Van Sant, Miss Belle,	5.0	George School, Pa.

The Five-lined or Blue-tailed Lizard is described as being black or yellowish with five yellow streaks, the middle one forked on the head, the tail usually light blue, older specimens reddish olive, the stripes very faint or sometimes missing; head becoming coppery red with age. While it is yet young or not more than four or five inches long the lines are plainly visible, but as it becomes older, these are lost in the males, while the females retain the distinct stripes throughout life. The males become a uniform dull olive brown on the body, with bright red about the head. This gives the explanation to the common name, "Red-headed Lizard." The change in the color as this reptile increases in size and age has caused some writers to describe it under different specific names when found representing different ages. It attains a length of eleven inches, while the largest we have in our collection is about six inches in length. Its largest size is reached in the Southern States, while in Pennsylvania, New York and New Jersey the average size of a mature specimen is about six inches.

Owing to its extreme rapidity it is one of the most difficult creatures to capture, and for that reason often escapes collectors, when other creatures of the same region would be taken more abundantly. The one which we collected in Centre county was on a post near an

old saw mill, and after wrapping the entire post from bottom to top in a sheet of mosquito netting, it was enclosed within the netting and even then by a sudden dash managed to escape through a chance opening which it saw, and the collector found it necessary to wait until the next day when it reappeared upon the same post and was shot with dust shot. Ditmars says of this species, "The reptiles invariably bask or hunt for insect prey within a short distance of secure hiding places, such as a burrow under a fallen tree or a cavity in the trunk. Unlike many species of lizards that run for an indefinite distance when disturbed, then stop and peer back at the object of their fright, the Skink flashes out of sight at the slightest shadow. As it emerges from its burrow it looks cautiously about to ascertain whether all danger is past and the movement of a finger will send it back again."

These Lizards often ascend trees, and in fact the older ones appear to spend considerable time there. Holbrook says, "They choose their residence in deep forests and are commonly found about hollow trees, often at a height of thirty or forty feet from the ground; sometimes in the last year's nest of a woodpecker, out of which he thrusts his bright red head in a threatening manner to those who disturb his home. He never makes his habitat on or near the ground, and in fact seldom descends from the elevation unless in search of food or water. Although shy and timid he is very fierce when taken, and bites severely." The bite is not venomous and there is really no reason to fear it in the least. It is the older individuals that live mostly in the trees, while the younger ones live mostly in hollow stumps and under bark of decaying logs. They winter beneath the loose bark of trees where they may be found dormant, in company with other creatures hibernating in such places.

They reproduce by laying from four to nine oval eggs beneath loose bark and around which the female coils during the several weeks that they are incubating, but when the young emerge the parents pay no further attention to them (Ditmars).

The Skink feeds wholly in the daytime and finds concealment toward evening. Ditmars says, "The Skink is strictly diurnal, seeking its hiding place with the setting of the sun. Its food consists largely of insects, but well-grown specimens will feed upon the eggs of birds, or newly born wood mice, often discovered by the lizard as it investigates the crevices of fallen trees." Other writers have reported the food of this Lizard as follows:

"It will feed largely on the house fly."—Dr. Abbott.

"Food consists of insects."—Hay.

"One kept in captivity ate a number of wood mice" (Oniscus). It gorged itself with these and afterward died from wind colic."—Cope, in his "Crocodiles, Lizards and Snakes of North America," page 638,

Our specimens and records have shown that one specimen contained food, and this was a measuring worm or span worm, similar to the Canker Worms, being the larva of a Geometrid moth. This at least indicates the decidedly beneficial quality of this species of animal.

No. 2. *Eumeces anthracinus* (Baird). **The Black Skink.**

This little Lizard occurs in the mountainous or hilly districts from Pennsylvania to Texas, being most abundant in the Allegheny Mountains. In the State of Pennsylvania it was collected by its discoverer, Prof. S. F. Baird, near Carlisle, Pa., which is the origin of the type. It is rare in this State. The specific name "Anthracinus" means "coal-black," and refers to the color of the reptile, which has a coal-black band along the back. For this reason it is sometimes called the Black-backed Lizard. It is a dark olive green on the back with two distinct white lines on each side, while in the centre of each pair of stripes and bordering above them is a coal-black band. Below the lower stripe the color is olive. The head of the adult is reddish, but there is no great difference between the young and mature in colors.

The Black Skink has the scales in twenty-four rows around the body, and the form of the body is elongate and cylindrical. The total length is five and one-half inches, including the tail, which is about three inches long. Since this belongs to the same genus as the Blue or Five-lined Skink, the habits are no doubt very similar. It likewise feeds on insects and must be regarded as beneficial.

No. 3 *Leiolopisma laterale* Say. **The Ground Lizard.**

The generic or first name of this species refers to the smooth scales, and the specific or second name refers to the band along the side. We have not been fortunate enough to collect specimens of this species in Pennsylvania, but we have seen a specimen No. 3550, in Cornell museum, whichwas collected on the Caroline Hills near Ithaca, N. Y., April 13, 1892, by Messrs. W. J. Terry and Louis A. Fuertes. While it is abundant in the Southern States it is evidently rare in Pennsylvania, although it is to be found in this State. It occurs from New York southward through Florida and westward to Southern Illinois and into Mexico. It is called the "Ground Lizard," because of its habits of living on or near the ground, and in fact it is a burrowing species, often found beneath leaves. It is also called the Brown-backed Skink or Brown-backed Lizard, because of the color of its back, and Black-banded Lizard, due to the color of the dark band on its side. It is a very small, elongate Lizard, with quite small limbs, and more truly resembles a Salamander than does any

other Lizard. The back is chestnut or brown in color, while on each side there is a band edged with white. The abdomen is yellowish, the tail blue below and the head is short. The length of a mature specimen is about five inches.

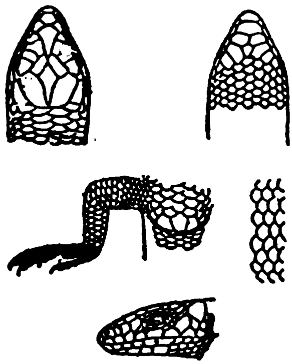

Fig. 27. Ground Lizard (*Leiolopisma laterale* Say). Kindly loaned by Prof. Morse, Curator of N. J. State Museum, from his Ann. Rep. 1906.

"In some portions of the Southern States this species of lizard is abundant. Holbrook says they might in his day be seen by thousands in the thick forests of oak and hickory of Carolina and Georgia. They emerge from their retreats after sunset, in search of small insects and worms on which they live; yet they appear and disappear so rapidly that they might at first be mistaken for crickets or other insects. It is difficult to secure them alive. They conceal themselves rapidly under roots or beneath leaves. It is said to breed in Georgie in March."—Hay. It is known that this Lizard feeds on insects on the ground in forests after night and has no objectional qualities. It is, therefore, proven to be beneficial and worthy of protection. "Although well protected by its sombre hues, these closely matching the ground, the Brown-backed Lizard has many enemies in the shape of snakes, particularly the young of the genus Ophibolus; the Scarlet Snake also feeds largely upon it. The Ground Lizard thrives in captivity if provided with an abundance of the proper food—ants, their larvae, and the grubs of smaller wood-boring bettles."—Ditmars.

FAMILY II. TEIIDÆ. THE STRIPED LIZARDS.

The animals of this family may be known by the flat, thin tongue ending in two long points. Its surface is mostly covered with overlapping scale-like projections or papillae. There are no bony

plates under the scales, as in the preceding family. Belonging to the family of Striped Lizards there are about one hundred and ten species, nearly all from Tropical America, but one occurs as far north as this State.

No. 4. *Cnemidophorus sexlineatus* (Linneaus). **The Six-lined Lizard.**

This Lizard is variously known as the six-lined Lizard, Sand Lizard, Sand Trotter, Sand Skeeter, Sand Sister and the Long-tailed Swift. The first or generic name means "wearing leg armour," and the second or specific portion of its scientific name refers to the six lines found on its body.

It is found from Connecticut to Florida and westward to California, northward to Nebraska and Wisconsin, while in its southern range it extends into Mexico. It is distinctly brown, with three yellow streaks on each side and the spaces between the lines jet black. The throat is silvery, while the under side is blue in the males. There is a greenish stripe on the back of the thigh at each side, prolonged on the tail. The older individuals are about the same color as the younger. It attains a length of not more than ten inches.

The Six-lined Lizard is one of the ground-inhabiting Lizards, rarely climbing trees, but frequenting dry sandy places. They dig burrows in which they pass the night and in which they find protection when pursued. The are remarkably swift when on the ground, and being keen eyed are able to escape a pursuer without great difficulty.

Some writers have written of the food of the Six-lined Lizard as follows:

"Its food is principally insects. Dr. Coues saw it catch flies in a tent."—Hay.

"It can run with such speed that no insect, not even the wary Tiger beetle, can escape it except by flight. It lives upon grasshoppers, cock roaches, tiger beetles and other beetles."—Hartman, in "Transactions of Kansas Academy of Sciences."

"For the most they are insectivorous, but the adults are not averse to feasting upon the eggs of small birds that build their nests on the ground. The Lizard cracks the shell with its strong jaws and laps up the contents with the long, flat forked tongue. All of the species lay thin-shelled eggs. The female scoopes out a hollow in the sand and, carefully covering the eggs, leaves them to be hatched by the sun's heat."—Ditmars.

FAMILY III. IGUANIDAE. THE IGUANAS.

The Lizards belonging to this family are to be recognized by the thick tongue, almost entirely fixed to the floor of the mouth, and

by the little notches in front, without scales, but with only very fine papillae. This is a large family of three hundred and twenty species, found mostly in the hotter parts of America, but with one species occurring commonly in the State of Pennsylvania. This belongs to the genus Scelopórus, meaning "leg-pore," referring to some small pores in the legs.

No. 5. *Sceloporus undulatus* (Latrielle). **Common Lizard. Swift.**

This reptile is variously known as the Common Lizard, Brown Swift, Swift, Alligator Lizard, Pine-tree Lizard, Pine Lizard, Brown Scorpion and Fence Lizard. It occurs in the United States in forests

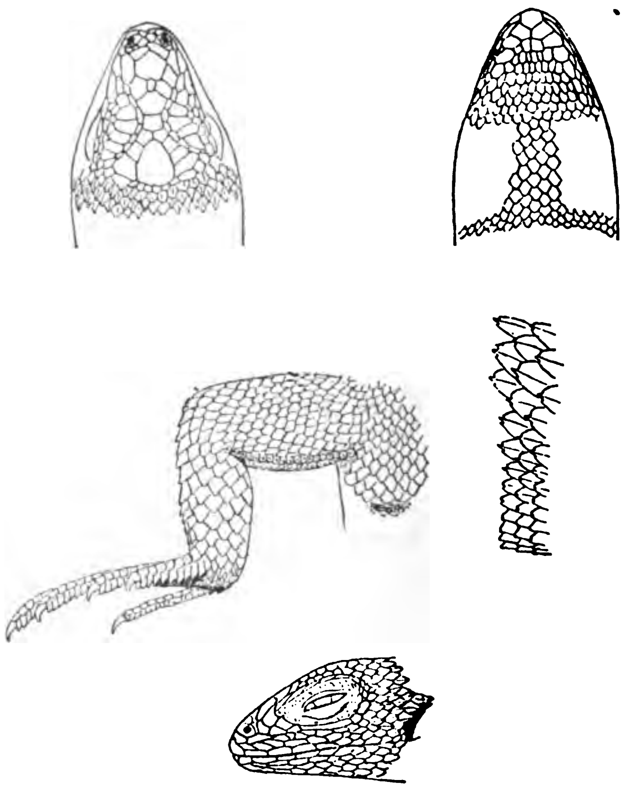

Fig. 28. Common Lizard (*Sceloporus undulatus* Daud.). Kindly loaned by Prof. S. R. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

and along fences as far north as New York and Michigan, and is very abundant southward. It is found westward to the Pacific Ocean, as far north as Oregon. It is the most common Lizard in Pennsylvania, being found in our collections and contributions as follows: (N. B.—The length is given in inches.)

Length.			
4.6	Berks county,	Sternbergh, H. M.,	Reading.
5.6	Bucks county,	Van Sant, Belle,	George School.
4.25	Clearfield county,	Buck, H. S.,	Clearfield.
3.0	Dauphin county,	Shuey, J. A.,	Dauphin.
6.4	Dauphin county,	Zinn, W. H.,	Dauphin.
(a) 2.6 (b) 6.0	Dauphin county,	Suskey, John C.,	Harrisburg.
1.1	Dauphin county,	Urich, D. C.,	Penbrook.
2.2		Phillips, Jos.,	Williamstown.
5.6	Franklin county,	Small, L. B.,	Marion.
4.4	Franklin county,	Atkinson, Mr.,	Mont Alto.
2.4	Franklin county,	McNeal, Jas.,	Mont Alto.
(a) 5.6 (b) 5.4 (c) 6.6	Fulton county,	Mosebey, W. L.,	Wells Tannery.
6.5	Juniata county,	Landis, G. & J.,	McCulloch's Mills.
5.75	Perry county,	Hooke, B. P., Jr.,	Landisburg.
2.8	Perry county,		Landisburg.
5.75	Perry county,	Brightbill, H. A.,	Marshrun.
5.0	Perry county,	Brightbill, H. A., Jr.,	Marshrun.
(a) 6. (b) 3.26	Snyder county,	Keller, W. I.,	Beaver Springs.
3.3	York county,	Johnson, J.,	Woodbine.
6.0	Saint Tammany Co., La.,	Geist, Karl,	Covington, La.
...	Ocean county, N. J.,	O'Connor, H. J.,	Tom's River, N. J.
5 0	Mechlenburg Co., Va.,	Van Sant, Belle,	George School, Pa.
(a) 4 (b) 5.4	Wayne county, W. Va.,	Van Ostrand, H. T.,	Bowen, W. Va.

The Swift is greenish, bluish or bronze with wavy cross bands above, often in the shape of irregular "V's." On each side of the back is an indistinct paler band, about ten rows of scales between the two. The males have a black blotch under the chin enclosed in a blue area, and also two large bluish patches on the sides of the abdomen. There is no blue on the under side of the female.

The scales on the back are rather large and very strongly keeled and pointed. In this regard this species differs from all other species of Lizards found in this State. The body is depressed or flattened; the tail slender; the head with large plates on the upper surface; the total length is about seven inches.

The Swift or Common Lizard is found in forests and along fences, rather rarely in the northern and central portions of this State, but much more commonly southward. It not only varies in color, but has the peculiarity of changing its color at will to some extent, somewhat as does the Chameleon of the Southern States, which belongs to the same family. In some parts of this State it is called the Rock Lizard or Log Lizard, for the reason that it is so frequently found on rocks and logs. It may particularly be sought around saw mills where there are logs with loose bark, and where insects are generally present in considerable numbers. In such places the Lizards find not only protection but also food.

We should again emphasize the point that this little reptile is entirely harmless and has no power of inflicting injury whatever, although most persons are deadly afraid of it and regard it with indescribable horror and fear. The Swift is very easily and quickly tamed, and thrives in captivity if kept in a cage entirely dry, given as much sunlight as possible and fed on meal worms and other soft-bodied insects or upon pieces of lean meat cut fine and moved before it on the end of something like a toothpick. We have fed them many times by putting the food on the point of a very small

stick or long pin and moving it before them enough to make it have the appearance of living and moving. They do not feed upon dead or quiet objects.

Ditmars says of them, "Their movements upon a large, fallen tree trunk, were very amusing. When approached they would dart at the opposite side of the trunk to that upon which one was approaching. As the collector's body loomed over the trunk the Lizard would shift its position until it was directly beneath. If every movement of one's approach were slow and cautious, capture was comparatively simple, for all to be done was to make a rapid grab with the hand on the opposite side of the log from that on which the bulk of the collector's body appeared. But alas! This grab could not be regulated to the nicety as if you were actually looking at your object, and, although the hand approached with lightning-like rapidity, the lizard started away from it at the same rate. The result was, in many cases, that you did grasp the creature, but by the tail. A second later a dark object scurries over the sand in direct line for a tree, and up it darts, while you ruefully examine a wriggling tail from which the original owner had twisted itself free.

"The eggs of this species are from three-eighths of an inch to one-half inch in length according to the size of the female. They are oval and covered with a very thin papery shell; it is indented upon the slightest pressure of the fingers. The eggs may be hatched by placing them in moderately damp, not soggy, sphagnum moss, and keeping them in an ordinary room temperature, where their period of incubation is from six to eight weeks. Concerning the reproduction of this Lizard, Dr. Hay adds, "The eggs are said to be laid in the sand, probably in little groups. They are deposited about June first, and are hatched about July 10th. The eggs are long and narrow, are covered with a tough coate, and are without any calcareous material. The egg weighs about twenty grains. They are abandoned to their fate, but when the young are hatched they are treated with the utmost gentleness by all the adults."

Smith in his "Report of the Reptiles and Amphibians of Ohio," says, "The swift probably hibernates beneath old bark. It does not become adult until two years of age. In Georgia it breeds in April."

In another publication by Eckel and Paulmier, of the University of the State of New York, Bulletin No. 57, the authors say, "Its eggs, which are long and narrow, are laid in the sand about June 1st, and hatched about July 10th."

Concerning the food of the Swift, authors have written as follows:

"It feeds on insects about the bark of trees, about logs and on fences."—Fowler in the N. J. State Museum Report, 1906.

"Their food consists of flies, ants, small spiders and the like. Abbott came to the conclusion that their vision is not acute, while their hearing is more searching. In endeavoring to catch flies they often missed their aim, although the insects were within their easy reach."—Hay.

"This lizard abounds in sandy regions, especially along streams. Examinations of five individuals showed that they had eaten grasshoppers (mostly nymphs), ground beetles and leaf hoppers."—Hartman.

Our examination of the food of the common Swift shows results as follows,—the first number being the number of the individuals of this species containing the respective kind of food mentioned, and the second number is the percentage which were found feeding upon this respective material in reference to the total number examined:

	No.	Per cent.
Molusca—Snails,	3	12
Arthropoda:....		
Crustacea—Oniscidæ, "Sow Bugs,"	1	4
Arachnida—Spiders,	5	20
Insecta,	25	100
Undetermined Insects,	9	36
Plecoptera—Perlidæ, Stone Flies,	1	4
Orthoptera, Grasshoppers, etc.,	6	24
Acrididæ, Short-horned Grasshoppers,	5	20
Undetermined species,	1	4
Malanoplus sp., Grasshopper,	2	8
Melanoplus femur-rubrum, Red-leg,	1	4
Tetix sp., Small Grasshopper,	1	4
Locustidæ—Atlanticus sp., Grasshopper,	1	4
Gryllidæ, Crickets,	2	8
Gryllus sp.,	1	4
Gryllus pennsylvanicus, Pa. Cricket,	1	4
Hemiptera, Bugs,	3	12
Heteroptera,	3	12
Undt.,	1	4
Pentatomid Undt., Stink Bugs,	1	4
Podisus sp.,	1	4
Lepidoptera,	7	28
Undet.,	1	4
Undet., larvæ	4	16
Geometridæ, Measuring Worm,	1	4
Noctuid larvæ, Cutworms,	2	8
Diptera—Undet. sp., Flies,	1	4
Coleoptera,	15	60
Undet.,	11	44
Larvæ,	2	8
Staphylindæ, Rove Beetles,	1	4
Elateridæ,	3	12
Nitidulidæ—Ips quadriguttatus,	1	4
Chrysomelidæ, Leaf Beetles,	1	4
Chrysomela sp.,	.1	4
Hymenoptera,	8	32
Undet sp.,	4	16
Ichneumonidæ—Undet.,	3	12
Myrinicidæ—Undet.,	1	4

From a study of the above table we get the new and interesting point that snails may constitute a very high percentage of the food of these Lizards, and at the same time they are decidedly insectivorous, feeding upon insects, belonging to different families, and

often taking insect larvae. Thus the value of this despised Lizard is distinctly proven and the recommendation is given to preserve these creatures for their beneficial services.

LIST OF REFERENCES FOUND IN THIS BULLETIN.

1882, Dr. Smith, "Report of Reptiles and Amphibians of Ohio," from Report of Geol. Survey of Ohio, Vol. IV., Part 1, Zoology, Columbus, Ohio.

1892. Dr. O. P. Hay, "The Batrachians and Reptiles of the State of Indiana," Department of Geology and Natural History, Resources of the 17th Annual Rept. (for 1891), Indianapolis, Ind.

1900, Dr. E. D. Cope, "The Crocodilians, Lizards and Snakes of North America," Smithsonian Institution, U. S. N. M., Washington, D. C.

1902, Eckel & Paulmier, "N. Y. Reptiles and Batrachians," Univ. of State of N. Y., Albany, 1902.

1905, C. W. Nash, "Check List of Reptiles," "Batrachians and Mammals ofOntario," Department of Education, Toronto, Ont.

1906, W. Stone, "Notes on Reptiles and Batrachians of Penna.," N. J. and Del., Am. Nat. XL., 1906, p. 159-170.

1906, F. A. Hartman, Wichita, Kansas, "Food Habits of Kansas Lizards and Batrachians," Tr. Kas. Sc. Sci., XX., pt. 2, Dec., 1906.

1907, Henry W. Fowler, "A Report of the Amphibians and Reptiles of New Jersey," Annual Report of the New Jersey State Museum for 1906, Trenton, N. J.

1907, R. L. Ditmars, New York, "The Reptile Book." 8 color plates, 400 photographs from life and 472 pages.

ACKNOWLEDGMENT OF SPECIMENS RECEIVED BY THE ECONOMIC ZOOLOGIST.

We take pleasure in acknowledging the following contributions of specimens:

SPECIMENS RECEIVED DURING OCTOBER, 1907.

For each entry of which the species is determined a common name is given, followed by the scientific name. Following entries are given with the common name when that is definite and with the scientific name when the common name is not a definite name, allowing the contributor to trace the list back for the scientific name as given where first mentioned.

Number.	Specimen.	Date—October, 1907.	Name and Address.
	Insects.		
10912	(b) Morning Sphinx (Deilephila lineata), (c) Milkweed Caterpillar (Euchaetias egle),	1	W. O. G. West, Danville.
10914	Hickory Horned Devil (Citheronia regalis),	1	H. H. Hawkins, Spring Forge.
10915	Mole Crickets (Gryllotalpa sp.),	1	W. R. Rohm, Harrisburg.
10916	Pine Leaf Scale (Chionapis pinifolii),	1	S. N. Baxter, Wenonah, N. J.
10917	Hickory Horned Devil,	1	A. H. Stevens, Enid.
10920	Beetle larva,	1	M. L. Sheetz, Harrisburg.
10926	Hag Moth larvæ (Phobetron pithecium),	2	A. J. Snyder, Greencastle.
10928	(a) 15-spotted Lady Beetle (Anatis ocellata), (b) Clover Weevil (Phytonomus punctatus),	2	Mrs. M. M. Hildebrant, Mt. Joy.
10929	Sphinx larva,	2	L. M. Simmons, Linglestown.
10931	Broad-winged Katydid (Cyrtophyllus perspicillatus),	2	A. E. Fisher, Duncannon.
10932	(a and b) Plant Lice, (c) Book Lice, (d) Collembola, (e) Fly larva,	2	Mr. Witman, Cornwall.
10925	Warble Fly Larva,	2	C. S. Ebersol, Mechanicsburg.
10939	(b) Parasitized Aphids,	3	R. C. Beaver, Greenville.
10941	Hag Moth larvæ,	3	Miss L. Bruner, Denver.
10942	Aphids,	3	T. Wood, Harrisburg.
10943	(a) Io Moth larvæ (Hyperchirio io) (b) Saddle-back Larva (Sibine stimulae),	3	C. A. Reichle, York.
10944	(a) 5-spotted Sphinx (Phlegethontius 5-maculata), (b) Milkweed Butterfly (Danais plexippus),	3	J. E. Degler, Tulpehocken.
10945	(a) Sphinx larva (pholus pandorus), (b) Moth larva (Noctuidae), (c) Tachina Fly larvæ,	3	G. B. Croop, Tunkhannock.
10946	Pholus pandorus larvæ,	3	Miss M. Whiteman, Reading.
10947	(a) Io larvæ, (b) Polyphemus larvæ (Telea polyphemus), (c) Imperial Moth larvæ (Eacles imperialis), (d) Promothea larva (Callosamia promothea),	3	S. Baldy, Catawissa.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
10948	Lappet Moth (Tolype velleda),	3	F. W. Kolb, Easton.
10949	P. pandorus larva,	3	L. C. Long, Listie.
10951	14 species of insects,	4	S. Baldy, Catawissa.
10953	(b) Bird Lice,	4	A. F. Boettcher.
10957	Eggs of Geometrid Moth,	4	H. F. Walker, Elkland.
10958	(a) Hag Moth larva, (b) Parasitized Moth larva,	4	A. Hile, Curwensville.
10960	Imperial larva,	4	Prof. G. P. Singer, Lock Haven.
10961	Long-horned Grasshopper,	4	G. Mall, Harrisburg.
10966	Drone Fly (Eristalis tenax),	5	A. B. Miller, Barnesville.
10967	Noctuid larva,	5	Mrs. J. W. Stang, Springville.
10968	(a) Arctiid larva, (b) Arctiid larva, (c) Rosy Maple Worm (Dryocampa rubicunda),	5	Mrs. J. W. Atkinson, Buckingham.
10978	Oyster-shell Scale (Lepidosaphes ulmi),	7	J. R. Snavely, Harrisburg.
10979	Milkweed Butterfly chrysalis,	7	W. R. Klinger, Valley View.
10980	Oil Beetle (Meloe americanus),	7	H. Likert, Blacklick.
10981	(a) Oil Beetle, (b) Milkweed Butterfly Chrysalis,	7	G. F. Hurr, DuBoistown.
10991	Walking Stick (Diapheromera femorata),	8	A. B. Geary, Wallingford.
10993	Saddle-back Larva,	8	J. W. Fox, Mt. Pleasant.
10995	6 species of insects,	8	F. M. Bream, Gettysburg.
10996	(a) Sphinx Larva (Sphinx drupiferarum), (b) Moth Irava,	8	H. Van Waltersdorf, Hanover.
10997	(a) Bird Fly, (b) Saddle-back larva,	8	M. B. Bergey, Souderton.
10998	(b) Imperial larva,	8	Dr. W. W. Climenson, Honey Brook.
10999	Bag Worm (Thyridoptery ephemeraeformis),	8	J. C. Knox, Gettysburg.
11000	(a) Oil Beetle, (b) Stink Bug (Pentatomidæ), (c) Lady Beetle (Megilla maculata),	8	H. K. West, Danville.
11001	Cicada,	8	F. Slaser, Harrisburg.
11008	(a) Imperial larva, (b) Moth eggs,	9	Mrs. J. W. Atkinson, Buckingham.
11009	Soft Scale (Eulecanium cerasifex),	9	W. H. Bullock, Honesdale.
11011	Terrapin Scale (Eulecanium nigrofasciatum),	9	B. F. Evans, Berwick.
11012	Cadelle larva (Tenebrioides mauritanica),	9	Mrs. E. O. Sanborn, Erie.
11013	Gold Beetle (Coptocycla signifera),	9	J. W. Leibengood, Harrisburg.
11015	Imperial Moth pupa,	9	L. M. Simmons, Linglestown.
11016	Larva of ten species of insects,	10	S. Baldy, Catawissa.
11022	San José Scale (A. perniciosus),	10	B. Brace, Keelersburg.
11023	Scurfy Scale (Chionaspis furfurus),	10	J. E. Jamison, Mines.
11025	Cicada,	10	Miss M. E. Zimmers, Bedford.
11026	Fig-eater (Allorhina nitida),	10	W. B. Ridenour, Scranton.
11027	Hemisphaerical Scale (Saissetia hemisphaerica),	10	B. A. Boyer, Mandata.
11028	Wheel Bug (Prionidus cristatus),	10	D. Metz, Harrisburg.
11029	Cicada,	10	D. W. Post, Towanda.
11033	Aphids,	12	H. Inman, Philadelphia.
11034	Stink Bugs,	12	W. D. Dixon, St. Thomas.
11035	San José Scale,	12	J. H. McLanahan, Hollidaysburg.
11036	Tachinid Fly larva,	12	Miss N. Biles, Wyalusing.
11037	(a) Arctiid Moth Larvæ, (c) Sawfly Larvæ, (d) Phycid Moth larvæ,	12	Miss M. L. Dock, Fayetteville.
11044	Collection of 13 species of insect larvæ,	14	Dr. W. W. Climenson, Honey Brook.
11045	(b) Bird Louse,	15	R. W. Wehrle, Indiana.
11046	Imperial Larva,	15	E. C. Atkinson, Buckingham.
11047	Aphids,	15	W. B. Davis, Philadelphia.
11048	(a) Lappet Moth, (b) Limacodid Moth Larva, (c) Cicada,	15	D. J. Weber, Meadville.
11049	(a) Dragon Fly Larva, (b) Backswimmer (Notonecta undulata), (c) Water Beetle (Dineutes discolor), (d) Water Boatmen (Corisidæ),	15	E. E. Sensenig, Emaus.
11052	San José Scale,	16	W. H. Sweitzer, Stewartstown.
11053	(c to g) 5 species of insects,	17	J. J. Palmer, Greenville.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
11057	San José Scale,	17	N. B. Cooper, Slatehill.
11058	(a) San José Scale, (b) Scurfy Scale,	17	J. Waltman, Bethlehem.
11059	Maple Pseudococcus (Pseudococcus aceris),	17	Miss A. M. Deers, Pittsburg.
11060	Oil Beetle,	17	N. S. Brown, Springville.
11062	Aphids,	17	H. W. Lush, Galeton.
11067	Katydid Eggs,	18	H. C. Baldwin, Berwyn.
11069	Mole Cricket,	18	F. V. Brayman, Blooming Valley.
11071	Oyster-shell Scale,	18	R. H. Kell, Blain.
11076	(c) Cecropia larva (Samia cecropia)	19	S. S. Carpenter, Ulysses.
11077	5-spotted Sphinx,	19	M. M. Hall, Fleming.
11078	Oyster-shell Scale,	19	A. M. Ryan, Towanda.
11079	Moth larva (Harrisimenna trisignata),	19	C. F. Harbaugh, Sewickley.
11080	(a) Walking Stick,	19	J. E. Senft, Hanover.
11081	(a) Io larva, (b) Dark Moth (Feltia subgothica),	21	Rev. W. H. Pickop, Pine Grove.
11087	Wooly Aphis,	22	D. H. Bauman, Munhall.
11088	Parasitic Hymenoptera cocoons,	22	W. H. McElwee, Harrisburg.
11090	Walking Stick,	22	B. D. Latshaw, Dornsife.
11096	Papilio turnus larva,	24	W. A. Warner, Pineville.
11097	(a) Butterfly Chrysalis, (b) Cecropia cocoon,	24	Mrs. J. W. Stang, Springville.
11098	Aphids,	24	C. B. Culp, Schellsburg.
11099	Katydid Eggs,	24	C. S. Mills, New Castle.
11101	Mole Cricket,	25	J. A. Faust, Shippensburg.
11105	Oyster-shell Scale,	26	J. R. Turner, Sanatoga.
11106	Oestrid fly warble,	26	P. M. Crane, Towanda.
11110	Walking Stick,	28	H. Behler, Pittston.
11111	Hemisphaerical Scale,	28	C. A. DeLong, Eaglesmere.
11112	San José Scale,	28	J. K. McLanahan, Hollidaysburg.
11118	(a) Work of Codling Moth (Carpocapsa pomonela), (b) Beetle larvæ (Apion),	29	J. C. Snyder, Boardman.
11119	(a) Aphids, (b) Scurfy Scale,	29	J. M. Schenck, Enid.
11121	Sphinx Larva,	29	Miss E. M. Gilmore, Buckingham.
	Invertebrates Not Insects.		
10918	Red Mites,	1	E. Wells, Wilkes-Barre.
10930	Millipedes,	2	H. M. Dellinger, Paradise.
11932	Millipedes,	2	Mr. Witman, Cornwall.
10953	(c) Mites,	4	A. F. Boettcher, Rolands.
10956	Mites,	4	J. R. Armont, Plainsville.
10959	Lycosid Spider,	4	L. B. Cushman, North East.
10968	(d) Spider,	5	Mrs. J. W. Atkinson, Buckingham.
11008	(b) Cray fish (Cambarus sp.),	9	J. Pruss, Harrisburg.
11014	Spider,	9	L. R. Metzger, Harrisburg.
11037	(b) Epeirid spider cocoon,	12	Miss M. L. Dock, Fayetteville.
11051	Mites,	16	W. J. Hallowell, Hallowell.
11058	(h) Spider,	17	J. J. Palmer, Greenville.
11061	(a) Centipede,	17	J. B. Swaney, Hookstown.
11068	Earthworm,	18	D. H. Bauman, Munhall.
11070	Spider,	18	E. R. Mulford, Wellsboro.
11080	(b) Spider,	19	J. E. Senft, Hanover.
11092	Spider,	23	C. D. Vorhees, Sonestown.
	Reptiles, Batrachians and Fishes.		
10907	2 Common Water Snakes (Natrix sipedon),	1	L. Yoder, Harrisburg.
10908	Musk Turtle (Aromochelys odoratus),	1	S. H. Derickson, Danville.
10909	(a) Queen Snake (Regina leberis), (b) Green Frog (Rana clamitans), (c) Leopard Frog (Rana pipiens), (d) Cave Salamander (Spelerpes longicauda),	1	J. Couch, Cannonsburg.
10910	Sculptured Turtle (Clemmys insculptus),	1	R. W. Wehrle, Indiana.
10911	(a) Newt (Diemictylus viridescens), (b) Land Salamander (Plethodon cinereus),	1	John Lawrence, Coatesville.
10912	(a) 2 Land Salamanders,	1	W. O. G. West, Danville.
10922	Common Garter Snake (Thamnophis sirtalis),	1	H. K. Peters, Belleville.
[illegible]	3 Common Garter Snakes,	1	Dr. C. Westbrook, Harrisburg.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
10924	Sculptured Turtle,	1	W. F. Stevens, Sterling.
10925	House Snake (L. d. triangulus),	2	M. M. Sweezy, Walker Lake.
10935	Common Box Tortoise (Terrapene carolina),	3	R. W. Wehrle, Indiana.
10936	Common Water Snake,	3	A. S. Kreider, Jr., Annville.
10937	(a) Common Water Snake, (b) Pilot Snake (callopeltis obsoletus),	3	Prof. I. L. Kinney, Portland.
10939	(a) Queen Snake,	3	R. C. Beaver, Greenville.
10950	Common Rattle Snake (Crotalus horridus),	4	G. W. Bowser, Shirleysburg.
10952	Sculptured Turtle,	4	A. A. Northrop, Brown Sta., N. Y.
10954	Common Garter Snake,	4	D. Bohn, Altoona.
10955	Red-bellied Snake (Storeria occipitomaculata),	4	L. V. Workman, State College.
10962	(a) 2 Queen Snakes, (b) Cave Salamander, (c) Common Toad (Bufo l. americanus),	4	Greenville High School, Greenville.
10963	(b) Painted Turtle (Chrysemys picta) (c) Blowing Viper (Heterodon platirhinos),	4	Pro I. L. Kinney, Portland.
10964	5 Sculptured Turtles,	5	R. W. Wehrle, Indiana.
10965	Red-bellied Snake,	5	H. R. Hammerle, Wilkes-Barre.
10969	Common Water Snake,	7	C. S. Ebersol, Mechanicsburg.
10971	Newt,	7	Dr. W. W. Climenson, Honey Brook.
10972	Newt,	7	J. K. Johnson, McConnellsburg.
10973	Common Garter Snake,	7	J. T. Blake, Fox Chase, Philadelphia.
10976	(a) 6 Blowing Vipers, (b) 40 Young House Snakes,	7	R. A. Blaksley, Weatherly.
10977	Hellbender (Cryptobranchus alleganisensis),	7	Miss G. Carn, Harrisburg.
10987	2 Blowing Vipers,	8	E. E. C. Gibbs, Huntingdon.
10989	Common Garter Snake,	8	A. C. Dearer, Catawissa.
10990	2 Granite Salamanders (Plethodon glutinosus),	8	C. E. Gere, Kingsley.
10992	Blowing Viper,	8	W. S. Tompkins, Eatonville.
10994	Land Salamander,	8	A. F. Kreider, Annville.
10998	(a) Varied Tree Frog (Hyla versicolor),	8	Dr. W. W. Climenson, Honey Brook.
11003	(a) 2 Common Garter Snakes,	9	J. P. Russ, Harrisburg.
11004	Common Box Tortoise,	9	S. Baldy, Catawissa.
11005	Common Garter Snake,	9	J. T. Blake, Fox Chase, Philadelphia.
11006	(a) Common Garter Snake, (b) Common Water Snake,	9	J. G. Detwiler, Fort Washington.
11007	(a) Common Garter Snake, (b) Grass Snake (Liopeltis vernalis),	9	W. Angus, Stoddartsville.
11017	Common Water Snake,	10	H. Horton, Harrisburg.
11018	(a) 2 Common Garter Snakes, (b) Ring-necked Snake (Diadophis punctatus), (c) 2 Blowing Vipers, (d) Black Snake (Bascanion constrictor),	10	Prof. I. L. Kinney, Portland.
11019	Grass Snake,	10	L. V. Workman, State College.
11020	Land Salamander,	10	H. W. Snyder, Pottstown.
11021	(a) 7 Purple Salamanders (Gyrinophilus porphyriticus), (b) House Snake, (c) 2 Ribbon Snakes, (d) Land Salamander,	10	J. L. Graf, Pittsburg.
11030	(a) 3 Land Salamanders, (b) Newt,	11	H. P. Huislander, Mainesburg.
11032	2 Sculptured Turtles,	12	R. W. Wehrle, Indiana.
11038	(a) Common Garter Snake, (b) Rock Snake (Storeria Dekayi).	14	E. M. Mixer, Waterford.
11039	Sculptured Turtle,	14	A. A. Northrop, Brown Sta., N. Y.
11040	Common Water Snake,	14	G. M. Lehman, Essington.
11041	2 Queen Snakes,	14	R. W. Wehrle, Indiana.
11042	Land Salamander,	14	S. D. Keeney, Philadelphia.
11045	(c) House Snake,	15	R. W. Wehrle, Indiana.
11052	(a) Common Garter Snake, (b) Rock Snake,	17	J. J. Palmer, Greenville.
11054	Common Garter Snake,	17	R. W. Wehrle, Indiana.
11056	(a) Black Snake, (b) 4 Land Salamanders,	17	Miss A. K. Bewley, Forest Grove.
11061	(b) Common Toad,	17	J. B. Swaney, Hookstown.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
11064	Common Garter Snake,	18	C. Yoder, Pleasant View.
11065	Red-bellied Snake,	18	D. K. McDermott, Karns City.
11072	House Snake,	19	G. E. Cressler, Shippensburg.
11073	Red-bellied Snake,	19	W. Lutes, Beaumont.
11074	Common Box Tortoise,	19	L. G. Schaum, Womelsdorf.
11075	3 Brown Salamanders (Desmognathus fusca),	19	Miss I. Eakman, Munhall.
11076	(a) 2 Common Garter Snakes,	19	S. S. Carpenter, Ulysses.
11086	House Snake,	22	W. G. Reedy, Newmanstown.
11091	Blowing Viper,	23	C. Knepp, Farrandsville.
11094	(a) House Snake, (b) Rock Snake,	24	Dr. H. F. Kocher, Wolberts.
11095	Leather-backed Turtle Eggs (Aspidonectes spinifer),	24	R. W. Wehrle, Indiana.
11103	Red Salamander (Spelerpes ruber),	26	Dr. J. S. Rittenhouse, Lorane.
11104	Grass Snake,	26	R. W. Wehrle, Indiana.
11113	(a) House Snake,	29	Mrs. J. W. Atkinson, Buckingham.
11114	Common Box Tortoise,	29	R. W. Wehrle, Indiana.
11115	Common Garter Snake,	29	T. H. Carpenter, Utica.
11116	Common Garter Snake,	29	S. G. Lausch, Schaefferstown.
11117	Spotted Salamander (Amblystoma punctatum),	29	A. K. Ludwig, Temple.
	Birds and Mammals.		
10913	Red Bat (Lasiurus borealis),	1	L. K. Hostetter, Landis Valley.
10938	Red Bat,	3	E. Moran, Lock Haven.
10940	Red Bat,	3	A. Barclay, Harrisburg.
10953	(a) Osprey (Pantion haliaetus),	4	A. F. Boettcher, Rolands.
10963	(a) Horned Grebe (Columbus auritus),	4	Prof. I. L. Kinney, Portland.
10970	Cat Bird (Galeocoptes carolinensis)	7	Mrs. J. W. Atkinson, Buckingham.
10974	Mole Shrew (Blarina brevicauda),	7	A. A. Davis, Clark's Green.
10975	2 Flickers,	7	B. Bedford, Starrucca.
11045	(a) Duck Hawk (Falco peregrinus) (b) Great-horned Owl (Bubo virgininus),	15	R. W. Wehrle, Indiana.
11050	Hermit Thrush (Hylocichla aonalaschkae),	16	E. C. Atkinson, Buckingham.
11055	4 Jumping Mice (Japus hudsonius),	17	F. M. Brubaker, Johnstown.
11066	Red Bat,	18	E. Graybill, Manheim.
11076	(b) Crow (Corvus americana),	19	S. S. Carpenter, Ulysses.
11107	Common Weasel (Putorius Noveboracensis),	28	R. W. Wehrle, Indiana.
11108	Short-eared Owl (Asio accipitrinus),	28	F. Craighead, Carlisle.
11113	(b) Mole Shrew,	29	Mrs. J. W. Atkinson, Buckingham.
11125	(a) 5 Song Sparrows, (b) 3 Blue Birds,	31	C. L. Brumbaugh, Wilkinsburg.

SPECIMENS RECEIVED DURING NOVEMBER, 1907.

Number.	Specimen.	Date—Nov., 1907.	Name and Address.
	Insects.		
11130	(c) Crane flies,	4	R. P. Carr, Olyphant.
11131	Angumois Grain Moth (Tinea pellionella),	4	J. H. Hyett, Wernersville.
11132	Noctuid larva,	4	R. V. Mitchell, Mehaffey.
11138	Rabbit Warble pupa (Oestridæ),	4	W. M. Boisinger, Ebensburg.
11140	San José Scale (Aspidiotus perniciosus),	6	A. E. Lesher, Chambersburg.
11141	Scurfy Scale (Chionaspis furfurus),	6	J. L. Ginck, New Oxford.
11142	Walking Stick (Diapheromera femorata),	6	Dr. G. Hetrick, Birdsboro.

SPECIMENS RECEIVED DURING NOVEMBER, 1907.—Continued.

Number.	Specimen.	Date—Nov., 1907.	Name and Address.
11143	Katydid Eggs (Locustidæ),	6	A. D. Wentz, Spring Forge.
11144	Braconid Cocoons,	6	R. V. Mitchell, Mehaffey.
11146	San José Scale,	8	W. E. Perham, Hawley.
11147	Terrapin Scale (Eulecanium nigrofactiatum),	8	J. F. Meck, Altoona.
11148	Meal Worm (Tenebrio molitor),	8	Dr. J. K. Kiser, Kittanning.
11150	Oil Beetle (Meloe americanus),	9	W. H. Bucher, Millerstown.
11152	Scurfy Scale,	9	H. Kniseley, Harrisburg.
11156	American locust (Schistocerca americanus),	12	C. M. Doum, Gettysburg.
11160	Katydid eggs,	14	N. A. Leonard, Dallastown.
11161	2-spotted Lady Beetle (Adalia bipunctata),	14	P. S. Tooker, Easton.
11162	Oyster-shell Scale (Lepidosaphes ulmi),	14	I. L. Kinney, Portland.
11165	Aphis Eggs,	18	C. S. Donough, Lebanon.
11171	Terrapin Scale,	19	D. S. Knestrick, Washington.
11177	Fleas from Squirrel,	21	State Museum, Harrisburg.
11178	White Grubs (Lacnosterna sp.),	21	Dr. W. W. Climenson, Honey Brook.
11179	San José Scale,	21	J. K. McLanahan, Hollidaysburg.
11180	Scurfy Scale,	21	W. T. Moore, Port Royal.
11181	San José Scale,	21	Sands & Beihman, Hawley.
11183	Chinese Mantis (Tenodera sinensis),	23	P. Laurent, Mt. Airy.
11186	Cecropia Cocoon (Samia cerropia),	23	T. Murray, Mountaindale.
11188	Aphis eggs,	21	J. F. Howden, Jefferson.
11189	Common Lady Beetle (Megilla maculata),	25	J. Hubbell, Bristol.
11192	Oyster-shell Scale,	27	E. R. Frost, Stoneboro.
	Reptiles, Batrachians and Fishes.		
11127	Common Water Snake (Natrix sipedon),	1	Prof. I. L. Kinney, Portland.
11128	Land Salamander (Plethodon cinereus),	4	H. W. Pretz, Allentown.
11137	(a) Grass Snake (Liopeltis vernalis, (b) Common Water Snake,	4	L. G. Goodenough, Girdland.
11138	Common Garter Snake (Thamnophis sirtalis),	6	M. Fasick, Harrisburg.
11149	Rock Snake (Storeria dekayi),	9	M. K. Berle, Milton.
11151	Spotted Salamander (Amblystoma punctatum),	......	E. B. Wright, Forksville.
11157	(a) Common Water Snake, (b) Blacksnake (Bascanion constrictor),	12	P. S. Tooker, Easton.
11166	(a) 11 Blowing Vipers (Heterodon platirhinos), (b) 5 Grass Snakes, (c) 3 Common Garter Snakes, (d) 2 Ring-necked Snakes (Diadophis punctatus), (e) 2 Common Water Snakes, (f) 4 Rock Snakes, (g) 3 Ribbon Snakes (Thamnophis sauritus), (h) Box Tortoise (Terrapene carolina), (i) 2 Granite Salamanders (Plethodon glutinosus), (j) 2 Newts (Diemictylus viridescens), (k) Red Salamander (Spelerpes ruber),	18	Prof. F. D. Keboch, Williamstown.
11169	Red Salamander,	19	Miss Grace Amon, Greenville.
	Birds and Mammals.		
11126	Barred Owl (Syrnium nebulosum),	1	P. D. Aurandt, Altoona.
11129	2 Cedar Waxwings,	4	H. K. West, Danville.
11130	(a) Jumping Mouse (Zapus hudsonius) (b) Tail of Flying Squirrel (Sciuropterus volans),	4	I. P. Carr, Olyphant.
11139	Barn Owl (Strix pratincola),	6	H. Rapp, Lions Sta.
11163	Skin of domestic cat,	18	W. H. Welliver, Danville.
11170	Meadow Mouse (Microtus pennsylvanicus),	19	P. S. Tooker, Easton.
11182	Great-horned Owl (Bubo virginianus),	22	R. W. Wehrle, Indiana.
11184	Screech Owl (Megascops asio),	22	T. B. McClure, Harrisburg.

THE ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

VOL. V, No. 9.

SUBJECTS: THE SAN JOSÉ SCALE.
1. Orchard Demonstrations.
2. Nursery Inspection and Tree Dealers.

January 1, 1908.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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CONTENTS OF THE JANUARY BULLETIN.

DEMONSTRATION ORCHARDS.

Judging from the many expressions received from practically every county of this State, our recently expressed plan of establishing Demonstration Orchards in the fruit-growing regions of Pennsylvania, will prove the most important step for our fruit growers that has yet been undertaken in the State of Pennsylvania. This plan strikes a popular chord because it meets in a practical way the popular demand. This is to be a teaching of the methods of controlling orchard pests by practical demonstrations, conducted in an available orchard throughout the entire year, and in fact during the portion of next year for which we have the funds.

Many of our practical citizens think that it is very easy to write bulletins and letters and tell how to do the work of suppressing the injurious insects and preventing plant diseases, but they appear to think that it is much more difficult actually to perform this work. Our citizens have rightly said "show me," and it is now for us to demonstrate these methods on a proper basis in the orchards in which we propose to control the conditions to such an extent as to show how to produce fruit as nearly perfect as possible, notwithstanding the presence of insect pests or plant diseases. In making such a proposition it becomes at once apparent that practical methods must be shown and actual beneficial results must be obtained or failure is inevitable.

In undertaking this the person in charge must know his business to such an extent as to have confidence in himself, in his work, and in the final results. This is in accordance with the most beneficial methods of carrying practical information to the tiller of the soil. It is to be hoped that in each county where these Demonstration Orchards are established the citizens interested in fruit growing will make every effort to obtain the information given by attending the meetings and visiting the orchards frequently to see what is done, and practice the methods in their own orchards.

The plan at present is for this office to take charge of an established orchard in each of the fruit-growing districts of the State, as far as the funds will permit, putting the average at about one Demonstration Orchard for two counties throughout the State. We shall prune and spray the orchard and even direct its cultivation and fertilization as far as may be necessary to demonstrate the proper methods to suppress, control or prevent insect pests and plant diseases, properly invigorate the trees, and produce fair crops of good fruit. These are not to be "experimental orchards" for

trying new materials or performing experiments of any kind, but they are for the purpose of demonstrating known modern methods along the latest tested and approved lines in horticulture.

It is the purpose of this office to establish such orchards, preferably at a public institution, such as the County Home, and make announcements through the bulletins, the press, and otherwise, concerning the selection made and the dates when certain kinds of work will be done in the orchard. The public will be invited to see the practical work done and then attend a meeting where addresses will be given upon the subject, explaining why certain things were done and why others were not undertaken, and questions will be answered. No doubt arrangements will be made for an evening meeting near each place of demonstration, where illustrated lectures will be given, showing proper and improper methods and their results.

This office offers to supply intelligent direction of the work in sending a person to assist with the pruning, spraying and other horticultural practice, and also to furnish the material needed for spraying and also the apparatus if there be none in the orchard. The owner will be expected to furnish help in doing the work and permit public access to this orchard for the purpose of letting observers make a study of it and the results. The owner is to have the benefit of the work done and the fruit produced.

It is desirable to have some young trees and some that are older, and also at least a small space for planting a few more, in order to show the methods of planting and especially the pruning of a tree from the beginning until after it has reached maturity. Some large or full grown trees are desirable, and if they be infested with San José Scale, and not in the best condition as to culture, care or growth, it will be all the better for this purpose.

Since the first announcement of this plan in the newspapers we have been gratified to receive many letters offering orchards for the demonstrations, but after carefully considering the subject and talking with many interested persons, it has been decided that it will be best to make use of the orchard of the County Homes or some other public institution in the county, for the following reasons:

(1) Help can be obtained there for carrying out the directions in detail, while on many farms this could not be had at the proper time for doing the work in the orchard.

(2) At a public institution the citizens would feel much more free to attend, enter the premises, inspect the work, and see results at any time.

(3) This will be really returning to the county something definite

in the way of benefits, as the production of more and better fruits for the institution will be a financial aid rendered directly by the State.

(4) The charge of political favoritism thus can not be made against us in accepting an orchard of a public institution, which might possibly be made if we should accept an orchard of a private individual in a county where already forty or fifty desirable or available orchards have been offered for this purpose.

(5) Such institutions are generally located nearly central in a county, and are liable to be available for the greatest number of citizens in the county.

(6) Such institutions generally have a room or hall large enough to be used as a public meeting room, in which we should desire to meet the fruit growers and farmers occasionally for discussion of subjects pertaining to the demonstration orchard.

It is individual help that should be given in this State, and when a man has invested several thousand dollars in fruit growing and arrives at the point that has been reached by many of our more extensive fruit growers in realizing the tremendous importance of the subject and the great amount of knowledge that must be obtained in order to push it forwaard successfully, he should be given such individual aid as he may need and which can be offered from such an office as this. Therefore, it will be our plan to meet the individual fruit grower, perhaps first at the Demonstration Orchard, and later in his own orchard, and give such instruction in the orchards as may be adapted to their own needs. This will be practical help that will necessarily result in much good.

Announcements will be made through the press, through our bulletins and otherwise concerning the dates of meetings, and the public is cordially invited to make use of the services that are thus carried to them.

There will not be only lectures and the exhibition of methods, but also the distribution of literature and scientific as well as practical information given.

The present plan of the establishment of Demonstration Orchards, subject to possible modification and announcement, is as follows:

County.	Owner.	Place.	Demonstrator in Charge.
Allegheny,	J. W. Nesbit,	Oakdale,	Frank L. McClure.
Beaver,	Beaver County Home,	Bellows,	Frank L. McClure.
Bedford,	Bedford County Home,	Bedford,	R. F. Lee.
Berks,	Berks County Home,	Shillington,	J. D. Herr.
Blair,	Orphans' Home,	Martinsburg,	R. F. Lee.
Bradford,	Bradford County Home,	Troy,	D. A. Knuppenburg.
Bucks,	National Farm School,	Doylestown,	E. L. Loux.
Butler,	County Home,	Butler,	Frank L. McClure.
Cambria,	County Home,	Ebensburg,	G. W. Sloop.
Chester,	County Home,	Embreeville,	Francis Windle.
Clearfield,	County Home,	Clearfield,	
Cumberland,	Indian School,	Carlisle,	F. Z. Hartzell.
Dauphin,	County Home,	Harrisburg,	P. H. Hertzog.
Delaware,	County Home,	Lima,	M. E. Shay.
Huntingdon,	Reformatory,	Huntingdon,	J. Bergy.
Indiana,	Frank Daugherty,	Indiana,	G. W. Sloop.
Jefferson,	Memorial Home,	Brookville,	G. W. Sloop.
Lackawanna,	Randolph Crippen Estate.	Dalton,	A. O. Finn.
Lancaster,	Home for Friendless Children.	Lancaster,	J. D. Herr.
	County Home,	Lancaster,	J. D. Herr.
Lawrence,	City Home,	New Castle,	J. W. Cox.
Lebanon,	County Home,	Lebanon,	F. R. Fertig.
Lehigh,	County Home,	Allentown,	E. C. Bowers.
Lycoming,	City Home,	Williamsport,	W. G. Winner.
Mercer,	County Home,	Lewistown,	James Bergy.
Mifflin,	County Home,	Mercer,	J. W. Cox.
Montgomery,	State Asylum,	Norristown,	J. S. Briggs.
Montour,	Pa. Insane Hospital,	Danville,	
Northampton,	Carter Junior Republic,	Redington,	P. R. Boltz.
Northumberland,	Odd Fellows' Orphans' Home.	Sunbury,	
Perry,	County Home,	Loysville,	T. C. Foster.
Potter,	County Home,	E. Coudersport,	M. L. Benn.
Schuylkill,	County Home,	Schuylkill Haven,	B. S. Moore.
Tioga,	County Home,	Wellsboro,	M. L. Benn.
Union,	J. N. Glover,	Vicksburg,	T. C. Foster.
Westmoreland,	County Home,	Greensburg,	G. W. Sloop.
York,	County Home,	York,	E. F. Peirce.

STATUS OF SAN JOSE SCALE IN PENNSYLVANIA.

In a Bulletin issued shortly after entering this office the present Economic Zoologist published the statement that two very important subjects before him, which shuold receive considerable attention, were Bird Preservation and Scale Destruction in this State. We now feel that much has been accomplished along both these lines. Concerning the former the Audubon Society, which is doing excellent work in this State, has reported to the American Ornithologists' Union that much of the sentiment for bird preservation in Pennsylvania is due to the work of this office. This is gratifying, and efforts should not cease along this line until the public is fully educated to the importance of preserving birds both for their ethical and economic value.

Concerning Scale Destruction much more is to be said. For about fifteen years the San José Scale has been sweeping over the orchards of Pennsylvania like a fire. Where it has entirely consumed or destroyed, new orchards have in some cases been planted, and better results are now being seen than ever before because it has forced the specilization of fruit culture, or, in other words, has made fruit growing a profession by causing a differentiation between farming and horticulture. The pests gradually destroying the fruit in this

State were so abundant and destructive that many of the growers were discouraged, but that the more progressive fruit men have learned how to treat the scale that they no longer fear it. In every County where much fruit is produced there are men who say they have no great dread of the presence of the once very deadly San José Scale. This is merely because they have learned that it is easily and quickly controlled if done in the right way, with the right material, and at the right time.

On the other hand, there are portions of our State where the San José Scale has not been known so long and where its ravages are yet not decidedly marked. This is to be compared with a fire raging in a city which results in the destruction of old or poor buildings and later in the erection of much better buildings as a result of the removal of the former. No wonder such men as Dr. Funk and J. H. Hale, among Pennsylvania's and America's greatest fruit men, respectively, have both exclaimed, "Thank God for the San José Scale!"

Almost invariably it is necessary for the San José Scale to be present in a community at least a few years in order to prove its destructiveness, and force the attention of the public to the necessity of attacking it if they intend to preserve their trees. It is almost impossible for our Inspectors to get orchardists to take prompt action when they find the San José Scale for the first time in an orchard where the owner has not already had some experience with the deadly effects of this pest. We have received several letters from persons stating that if they had acted upon our advice three or four years ago, it would have saved them many valuable trees and hundreds of dollars' worth of fruit. On the other hand, it is very gratifying to know that we have at hand many letters from persons who state that their action upon advice from this office has resulted in completely restoring their trees to health, vigor and usefulness in giving them splendid and profitable crops. From every fruit growing county in the State there have come gratifying reports of this kind. Thus it can be understood why we say that, in general, the San José Scale is under satisfactory control in the State of Pennsylvania, although it is spreading in some regions where it has not been known long enough to awaken the proper interest in its destruction.

One of the best signs of the times is the recent large production of fruits in the scale-infested regions, good prices, and especially extensive planting of young trees and orchards. From the central to the southern and southeastern portions of Pennsylvania the planting of young fruit orchards is unprecedented, and reliable nurserymen and tree agents have told us that during the past year

their sales exceeded those of nearly all previous five years. This means that the public is now becoming confident of success in saving their trees, and particularly becoming fully aware of the importance and profit in producing fruit instead of the cheaper farm crops.

Our inspections of orchards have resulted in notifying hundreds of persons in this State of the presence of the scale, when they did not previously suspect it, and in instructing thousands as to the best and cheapest methods of meeting this pest. Our public demonstrations in methods of making and applying the Lime-sulphur Wash, which is the best and cheapest remedy known for the San José Scale, have resulted in giving direct practical instructions to thousands of persons, and in doing much toward saving and restoring the fruit interests in Pennsylvania.

The work of nursery inspection from this office has resulted in cleaner nurseries in this State, and in materially checking the spread of this pest upon nursery stock. We can, with all confidence, recommend home-grown trees for the fruit growers of this State. Reports upon the orchard inspection and nursery inspection will be found in another portion of this Bulletin.

This office is desirous of taking advanced steps as rapidly as possible in consistency with the needs of the subjects treated. It is possible to attempt to force new features upon our practical citizens before they are ready for them, but the time is now ripe for a new move, which we have for some time contemplated. This is to be the establishment of demonstration orchards throughout this State for the primary purpose of showing how to control all kinds of orchard pests, including insects and plant diseases, and how to produce the best fruit at the lowest cost, upon the practical basis of the present known and tested methods. The subject of proposed demonstration orchards is discussed in another portion of this Bulletin. Careful attention is called to this article.

The work of this office is solely for the benefit of the public and the preservation of the property through the dissemination of scientific and practical knowledge. Therefore, the support of the public is requested to the extent of correspondence, giving accounts of opportunity to render service, reports of results of assistance already given and results obtained, contributions of specimens of animals and insects of various kinds asked for by us, notes on observations of habits of the undomesticated creatures and beneficial and injurious insects of this State, and particularly co-operation through our local inspectors and demonstrators.

No more important step has been taken for the fruit-growing industry in Pennsylvania than the establishment of competent local

inspectors in certain districts of the State to act under our direc instruction in making inspections, giving demonstrations and re·· dering such help in the control of pests as the public may need. The local newspapers give accounts of the work of these persons, publishing their names and addresses, and the public is earnestly requested to make use of the services these men have to bring them, and encourage them, as well as report to us any possible questionable transactions or evidences of incompetency. There is no possible political influence that can keep any man on our force if he be shown to be really incompetent, dishonest or disreputable. The mere fact that a man represents this office should be enough to obtain for him the confidence of the public and assure our friends in various parts of this State that we believe such men to be of the highest type, and worthy to associate with them and give them help. We solicit reports of their work as to whether this is satisfactory or not, and shall make every possible effort to render the work of the inspectors satisfactory at all times.

Correspondence may be addressed to them, according to the addresses given in another portion of this Bulletin, or to the undersigned.

H. A. Surface, Economic Zoologist, Harrisburg, Pa.

Detailed Reports of Inspections for 1907.

(Report of Inspections by Counties and Inspectors giving (a) Number of demonstrations; (b) Total number of persons in attendance at demonstrations; (c) number of orchard or rural inspections; (d) number of borough inspections; (e) number of rural premises found infested with San José Scale; (f) percentage of rural premises infested with San José Scale; (g) number of fruit trees represented in rural inspections in 1905 and 1906; (h) number of fruit trees represented in rural inspections in 1907. In a subsequent issue of the Bulletin we shall publish testimonials from a number of fruit growers who have applied remedies for the control of San José Scale, giving their formula with date of application and results.)

County.	Inspector.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
*Adams,	D. K. McMillan,	11	166		205				
Allegheny,								85,053	
Armstrong,								14,822	
Beaver,	A. L. McKibben,			581		2	0.00	8,416	56,506
Bedford,	R. F. Lee,	12	133	851	495	312	36.8	154,239	251,132
Berks,	J. D. Herr,	10	176	627	677	600	95.7	29,594	59,601
	R. F. Lee,			6	585	5	83.33	38,965	15,017
Blair,	J. Bergy,			98		4	4.3		
Bradford,	W. B. Packard,							47,257	
	J. S. Briggs,	3	139					3,995	121,171
Bucks,	E. L. Loux,	11	222	1,638		1,407	85.9		
Butler,	F. L. McClure,	4	56	1,551	20	56	3.54	10,161	171,347
Cambria,								34,557	
Cameron,								2,224	
Carbon,								13,233	
	C. C. Hess,	2	18	4		3	75.	63,943	440
Centre,	T. C. Foster,				227				
	E. L. Loux,	8	87	438	1,151	362	82.65	61,368	137,382
Chester,	F. Windle,	8	121	1,396	663	1,372	98.28		
Clarion,								13,947	
Clearfield,									3,825
Clinton,	A. T. Baird,							40,751	63
Columbia,								44,926	
Crawford,								6,350	
	F. Hartzell,	8	92	128		105	83.08	151,613	19,248
Cumberland,	W. H. Wolff,				222				
	P. H. Hertzog,	11	170	310	83	264	81.93		
Dauphin,	C. F. Noll,			15	22	15	100.		
Delaware,	M. E. Shay,	8	168	359	30	321	89.66	19,294	32,311
Elk,								2,997	
Erie,	W. F. Lewis,			31		1	3.23	134,026	2,306
Fayette,								8,875	
Forest,								8,848	
Franklin,	F. Z. Hartzell,	4	28		301			238,457	
Fulton,	F. Z. Hartzell,			12		3	25.	4,469	21,741
Greene,								6,459	
Huntingdon,	J. Bergy,			38		7	18.42	95,616	12,675
Indiana,	G. W. Sloop,	8	98	599	292	5	0.83	9,508	94,079
Jefferson,								24,417	
	J. Bergy,	4	43	998	93	516	51.70	27,712	115,497
Juniata,	T. C. Foster,	3	13	89		50	56.18		
	J. K. Owen,	4	60						130,336
Lackawanna,	A. O. Finn,			1,376	188	60	4.36		

	E. C. Bowers,	17	199	898	415	898	100.	99,408	67,817
Lancaster,	J. D. Herr,	10	159	813	57	11	3.51	....	....
	P. H. Hertzog,	....	....	....	41	....	....	....	....
Lawrence,	J. W. Cox,	1	5	413	....	28	6.78	....	47,389
Lebanon,	F. R. Fertig,	9	287	1,058	63	1,051	99.34	....	99,783
Lehigh,	E. C. Bowers,	....	....	348	....	348	100.	....	27,173
	J. K. Owen,	5	81	921	274	208	23.04	....	110,235
Luzerne,	A. W. Stephens,	1	52	5	....	2	40.	....	....
	C. E. Myers,	....	....	396	163	216	54.55	....	121,504
Lycoming,	A. W. Stephens,	1	16	....	....	....	....	....	....
	W. G. Winner,	24	324	729	361	84	11.52	....	....
Mercer,	J. W. Cox,	8	34	101	....	12	11.88	....	9,864
Mifflin,	J. Bergy,	....	....	....	65	....	....	....	....
	J. S. Briggs,	23	404	868	418	787	90.67	....	81,835
Montgomery,	M. E. Shay,	....	....	....	84	....	....	....	....
Montour,	A. W. Stephens,	2	14	31	1,020	29	96.77	....	....
Northampton,	P. R. Boltz,	6	102	579	....	554	95.68	....	45,218
	A. W. Stephens,	9	92	561	789	404	72.01	29,766	37,910
Northumberland,	P. H. Hertzog,	....	....	....	405	....	....	....	....
Perry,	T. C. Foster,	1	9	....	....	....	....	82,015	....
Philadelphia,	M. E. Shay,	7	83	194	484	163	84.02	22,076	47,319
Pike,	W. E. Perham,	....	....	....	....	....	....	6,061	....
Potter,	M. L. Benn,	3	35	899	110	....	0.0	163,890	....
	B. S. Moore,	....	....	667	....	337	50.52	150,092	250,499
Schuylkill,	P. H. Hertzog,	....	....	....	538	....	....	....	....
Snyder,	T. C. Foster,	20	168	986	688	277	28.09	139,898	251,435
Somerset,	H. H. Dutton,	....	....	....	....	....	....	8,022	....
Sullivan,	C. E. Myers,	....	....	656	195	100	15.24	161,285	50,879
Susquehanna,	A. O. Finn,	....	....	105	....	1	0.95	8,258	56,867
Tioga,	M. L. Benn,	....	....	2	....	....	0.0	13,727	338
Union,	T. C. Foster,	4	70	....	829	....	....	112,800	....
Venango,	J. W. Cox,	....	....	....	....	....	....	14,754	....
Warren,	F. Z. Hartzell,	....	....	....	....	....	....	28,550	....
Washington,	J. Fergus and W. S. Fisher,	....	....	....	....	....	....	38,172	....
Wayne,	W. E. Perham,	....	....	....	....	....	....	68,390	....
Westmoreland,	J. N. Woolman,	....	....	674	....	294	43.62	79,704	87,988
	D. A. Knuppenburg,	....	....	1,403	528	142	10.12	108,973	130,000
Wyoming,	J. K. Owen,	5	60	....	....	....	....	....	....
York,	E. F. Peirce,	7	134	475	57	434	91.37	181,365	26,087

*A number of good fruit-producing counties, like Adams and others, are to be thoroughly inspected this spring.

NURSERY INSPECTION.

Report of Nursery Inspection in Pennsylvania.

During the past year the inspection of nurseries has been pushed with more than usual vigor, during both the summer season and the winter. This is the second year that we have inspected nurseries during the winter time, and the results are found to be so beneficial that it is determined to continue this feature of the inspection. The summer inspection commences the first of August and is continued until all the nurseries of the State are thoroughly inspected, which is generally until about the middle of September. However careful and conscientious the Inspector may be at the time of inspection, it is impossible to find all the scale insects that may be concealed beneath green leaves and buds during the summer inspection, and also there is great danger that the scale may spread after this inspection is finished and infest nursery stock which was clean at the time it was inspected.

In order to be certain to find the San José Scale and other tree pests the February inspection is made when the trees are not in leaf, and there is a better opportunity to inspect them thoroughly and see that they are in proper condition for spring sales. The inspections have been made with greater care than ever before, and the nurserymen themselves have commended it and commented upon the thoroughness with which the present force of inspectors are doing their work. The results are gratifying to all parties concerned.

When the nursery inspection was first undertaken some of the nurserymen were opposed to it for the reason that they thought it was interfering with their rights and property, and that they should be permitted to sell the nursery stock grown on their own land if the infestation came by means for which they were not responsible. They now fully understand that to stay in the business permanently and continue to make sales they must of necessity sell good stock in good condition and satisfy customers. Thus they have become enthusiastic supporters of a very rigid system of nursery inspection.

The greatest evil threatening nursery stock in this State has been infested trees or shrubbery in the vicinity of nurseries, and the great danger of the San José Scale spreading readily from such trees to the nursery stock. Several cases of nursery infestation by such means were found by our inspectors a few years ago, and this justified the movement on our part to force the owners to rid their trees of such dangerous pests. As a consequence, last summer we gave considerable attention to inspecting trees and shrubs in the vicinity of nurseries but not on the same premises, and notified the owners that their property must be treated by certain means or it would be our duty to treat it or destroy it in order to get rid of the

scale threatening the nurseries, nursery stock and neighbors. We are much gratified to report that in every case prompt remedial action was taken by the owners, and the results are very gratifying to all parties concerned. Nurserymen report that they have had during the past season far less infestation from scale from surrounding premises than ever before, and we believe that by this method we can reduce the San José Scale reaching nursery stock and consequently extending into the orchards of this State.

Our requirements where trees are found infested in a nursery are to destroy all trees that can be found attacked by San José Scale, and fumigate all others from that nursery before they are sold or shipped. There has been considerable complaint made against fumigation, some persons claiming that it injured their trees, but we know of a series of fumigation experiments which show that three times the required dosage of one ounce of the Cyanide of Potassium to one hundred cubic feet of space resulted in no injury whatever to the trees or cuttings. It is by all means best to have nursery stock fumigated at the nursery before shipping, whether it be infested or not. The reports adverse to fumigation have mostly come from persons who wished to be excused from the trouble of insuring, by this method, the freedom of their trees from pests.

It is against the law to ship any nursery stock, of varieties liable to be attacked by San José Scale, into this State from any other State or Country without certificates both of inspection and fumigation being attached to each package, bale or bundle in the shipment. Persons who have an opportunity are invited to aid us in the prosecution of the law by watching for incoming packages at railroad stations, express offices, etc., which may not bear tags certifying both inspection and fumigation, as required by our State law. Reports of such infringement should be sent at once to the Secretary of Agriculture, with details of the facts of the case, with the name of the shipper as well as the consignee, and the railroad or express company carrying the shipment.

It is likewise illegal to sell, ship or transport any nursery stock, for any distance whatever in this State, without said stock having attached thereto a certificate of inspection, showing when and by whom it was inspected, and if it has been fumigated, a certificate or statement of fumigation must likewise be attached. Purchasers are advised to reject all shipments not tagged or labelled in accordance with these statements, and notify this office of observed infringements of the law.

The following is a list of the nurseries inspected and licensed in the State of Pennsylvania, giving the name, address, and area of each:

ADAMS COUNTY.

Name.	Place.	Acres.
H. G. Baugher,	Aspers,	1
C. A. Stoner,	Gettysburg,	3
Charles J. Wilson,	Mummasburg,	3
W. E. Grove,	York Springs,	3
H. R. Plank,	York Springs,	2
Oyler & Hortman,	Mummasburg,	3

ALLEGHENY COUNTY.

Elliott Nursery Co.,	Springdale,	33
G. R. Elliot, Diamond Market,	Pittsburg,	1
Mark E. Head,	Bellevue,	¼
John W. Jorden,	Millvale,	¼

BEAVER COUNTY.

Mackall Bros.,	Beaver,	15
*James Smith,	Beaver Falls,	2½
A. P. Goodwin,	Industry,	9
*J. Hoyt,	Industry,	18
*Henry Finley,	Industry,	3
*A. J. Freed,	Homewood,	7
*W. A. Freed,	Homewood,	3
*Joseph and Charles Engle, R. D. No. 2,	Beaver,	14
*Arnold Bros., R. D. No. 1,	Beaver Falls,	8
*Enoch Engle, R. D. No. 1,	Beaver,	7

BEDFORD COUNTY.

Austin Wright,	Alum Bank,	2

BERKS COUNTY.

Wenrich Bros.,	Robesonia,	½

BUTLER COUNTY.

Pierce Bros.,	Butler,	6

BLAIR COUNTY.

F. A. Bowser,	Newry,	¼

BUCKS COUNTY.

J. L. Lovett,	Emilie,	3
Henry Palmer,	Langhorne,	2
Horace Janney,	Newton,	5
D. Landreth Seed Co.,	Bristol,	2
The W. H. Moon Co.,	Morrisville,	200
S. C. Moon,	Morrisville,	50

*Grow berry or small fruit plants only.

BUCKS COUNTY—Continued.

Name.	Place.	Acres.
D. J. Youngken,	Richlandtown,	1
S. R. Trach, R. D. No. 1,	Springtown,	1
Jacob F. Krout, R. D. No. 1,	Perkasie,	2

CHESTER COUNTY.

Morris Nursery Co.,	West Chester,	200
The Conard & Jones Co.,	West Grove,	30
The Dingee & Conard Co.,	West Grove,	15
Rakestraw & Pyle,	Kennett Square,	200
J. A. Roberts,	Malvern,	6
Hoopes Bros. & Thomas,	West Chester,	600
J. B. Reif,	Spring City,	2
E. B. Keating,	Kennett Square,	1½
Clarence Bayles,	West Grove,	½

CLEARFIELD COUNTY.

W. S. Wright,	Clearfield,	½

COLUMBIA COUNTY.

Frank C. Harris, R. F. D.,	Light Street,	½

CRAWFORD COUNTY.

*Anderson Bailey, R. D. No. 66,	Cochranton,	13
*Henry Roberts, R. D. No. 66,	Cochranton,	3
*J. T. Reed, R. D. No. 66,	Cochranton,	2½
*Park Bailey,	Cochranton,	4
*Samuel J. Cooper, R. D. No. 58,	Cochranton,	5
*Lewis Swogger, R. D. No. 28.	Carlton,	1½
C. L. Unger, R. D. No. 11,	Meadville,	3
Pennsylvania Nursery Co.,	Shermansville,	25
*J. Q. Marsh,	Geneva,	1½
*L. L. Wood,	Geneva,	2
*Peter Schaffner, R. D. No. 2,	Meadville,	4
*James T. Irwin,	Cochranton,	1½
*Samuel Bailey, R. D. No. 66,	Cochranton,	1
Don T. Atkin, R. D. No. 41,	Linesville,	4½
*Lee Bailey,	Cochranton,	2
*Frank Wasson,	Meadville,	2

DAUPHIN COUNTY.

C. P. Scholl, R. D. No. 1,	Halifax,	5
Andrew Coble, R. D. No. 1,	Middletown,	6

DELAWARE COUNTY.

P. Z. Supplee,	Collingdale,	25
J. J. Styer,	Concordville,	3

*Grow berry or small fruit plants only.

DELAWARE COUNTY—Continued.

Name.	Place.	Acres.
M. F. Hannum,	Concordville,	½
W. E. Caum (Lessee),	Haverford,	5
John G. Gardner,	Villa Nova,	5
Phila. Hedge Co., 817 Arcade Building,	Philadelphia or Wayne,	5
H. H. Baltles,	Newtown Square,	5
Joseph H. Brinton,	Camp Ground,	¼

ERIE COUNTY.

*A. F. Youngs,	North East,	3
*Orton Bros.,	North East,	1
L. G. Youngs,	North East,	5
*D. C. Bostwick & Son,	Ripley, N. Y.,	5
*M. E. Kelly, R. D. No. 2,	North East,	4½
*A. J. Youngs,	North East,	3
*W. E. Smith, R. D. No. 3,	North East,	3½
J. G. Bagley,	North East,	1

FAYETEE COUNTY.

J. Sterling & Son,	Masontown,	1

FRANKLIN COUNTY.

Geo. H. Wirt (Forester),	Mt. Alto,	1
Henry Eicholz,	Waynesboro,	½

JUNIATA COUNTY.

Jos. H. Landis,	McCullough's Mills,	2
*S. H. Graybill,	Richfield,	5
*Wm. Banks,	Mifflintown,	5

LACKAWANNA COUNTY.

*George H. Colvin,	Dalton,	2
*Floyd H. Northup,	Glenburn,	1
John W. Shepherd, 945 Clay Ave.,	Scranton,	4

LANCASTER COUNTY.

John G. Engle,	Marietta,	6
A. H. Erb,	Lititz,	½
Maurice Brinton,	Christiana,	20
W. P. Bolton,	R. F. D. McCalls Ferry,	2
D. D. Herr,	Lancaster,	5
Wilson Kready,	Mt. Joy,	1

*Grow berry or small fruit plants only.

LANCASTER COUNTY—Continued.

Name.	Place.	Acres.
O. W. Laushey,	Bird-in-hand,	2
A. W. Root & Bro., R. D. No. 1,	Manheim,	20
David S. Herr,	Mountville,	3
M. H. Musser,	Lancaster,	2
Hiram Shearer,	Elizabethtown,	1
B. F. Barr & Co.,	Lancaster,	3
Frank A. Suter,	Lancaster,	½
*Mayer & Son,	Willow Street,	2

LAWRENCE COUNTY.

Name.	Place.	Acres.
J. W. Hayes, R. D. No. 3,	Edinburg,	1
Butz Bros.,	New Castle,	½
A. S. Moore,	New Castle,	1
D. W. Fisher,	New Wilmington,	½

LEHIGH COUNTY.

Name.	Place.	Acres.
W. B. K. Johnson,	Allentown,	30
Preston J. Kline,	Coopersburg,	5

LUZERNE COUNTY.

Name.	Place.	Acres.
I. A. Driggs,	White Haven,	
(Handles only native ornamental shrubs.)		
Miss M. A. Maffett,	Wilkes-Barre,	1

LYCOMING COUNTY.

Name.	Place.	Acres.
Evenden Bros.,	Williamsport,	1

MERCER COUNTY.

Name.	Place.	Acres.
*George E. Brocklehurst, R. D. No. 20,	Jackson Centre,	3
*J. W. & J. H. Allison, R. D. No. 10,	Mercer,	10
*J. T. McLean, R. D. No. 46,	Greenville,	4
*Hugh Hogue, R. D. No. 28,	Carlton,	1½
J. L. Hoobler & Sons, R. D. No. 34,	Hadley,	4
*W. A. Taylor, R. D. No. 46,	Greenville,	1½
*W. R. Cribbs,	Mercer,	3
*H. W. Allison, R. D. No. 9,	Mercer,	4
*R. S. Donnell,	Hadley,	½

MONTGOMERY COUNTY.

Name.	Place.	Acres.
Chris Koehler,	Cheltenham,	2
R. B. Haines & Co.,	Cheltenham,	4
C. H. Wilson Estate,	Gladwyne,	2
J. B. Heckler,	Lansdale,	4
J. W. Thomas & Sons,	King of Prussia,	70

*Grow berry or small fruit plants only.

MONTGOMERY COUNTY—Continued.

Name.	Place.	Acres.
J. Krewson & Sons,	Cheltenham,	22
T. N. Yates & Co.,	North Wales,	100
J. B. Moore,	Hatfield,	10
Adolph Mueller,	Hoyt,	15
T. Meehan & Sons, Inc.,	Dreshertown,	216
Wm. Sturzebecher,	Lansdale,	½
Edward D. Drown,	Weldon,	¼
Fred Shoosmith,	Hoyt,	¼
J. G. Steffin,	Norrestown,	¼
Somerton Nurseries, A. W. Bannard, Mgr., 125 S. 5th St., Phila.,	Somerton,	15

NORTHAMPTON COUNTY.

Theodore Roth,	Nazareth,	2

PERRY COUNTY.

Geo. A. Wagner, R. F. D.,	Landisburg,	1½

PHILADELPHIA COUNTY.

W. W. Harper,	Chestnut Hill,	500
Thos. Meehan & Sons, Inc.,	Germantown,	75
T. N. Yates & Co.,	Germantown,	6
John B. Lewis,	Bustleton,	10
A. F. O'Connell, 4103 Girard Ave.,	Philadelphia,	14
John Stevenson's Son,	Oak Lane,	2

POTTER COUNTY.

Geo. Jackson,	Ulysses,	1

SNYDER COUNTY.

W. J. Koch, R. F. D.,	McClure,	1

SOMERSET COUNTY.

M. T. Lancaster,	Harnedsville,	5
H. E. Daniels,	Harnedsville,	3

SUSQUEHANNA COUNTY.

*E. A. Smith,	Heart Lake,	8
*Geo. P. Sprout, R. D. No. 66,	Montrose,	4½

VENANGO COUNTY.

Venango Nursery Co., R. D. No. 1,	Franklin,	6

*Grow berry or small fruit plants only.

WESTMORELAND COUNTY.

Name.	Place.	Acres.
John McAdams,	Mt. Pleasant,	1

WYOMING COUNTY.

Name.	Place.	Acres.
*Silas Decker, R. D. No. 1,	Ransom, Lackawanna Co.,	3½
*F. H. Fassett,	Meshoppen,	1
*W. H. Swartwood, R. D. No. 1,	Ransom, Lackawanna Co.,	5

YORK COUNTY.

Name.	Place.	Acres.
Patterson Nursery Co.,	Stewartstown,	18
Geo. E. Stein,	East Prospect,	6
W. S. Newcomer,	Glenrock,	4
E. J. Weiser, R. D. No. 11,	York,	½

Licensed Tree Dealers.

It is necessary for each tree dealer in Pennsylvania to procure a license or certificate from the Department of Agriculture, permitting him to transact his busness in this State. However, it is not necessary for the tree agent to obtain such license.

The difference between the tree agent and tree dealer is that the former represents some one nursery acting for them upon commission and not handling any stock beside that for which he has direct orders. Of course it is impossible for any nursery to transact business or sell or deliver stock in this State, without a license, and consequently the person who is acting as direct agent for any nursery is selling under the license or certificate of his firm. Thus the agent is regarded as holding a license by virtue of the one which his firm must obtain to transact business in the State.

By the term "Tree Dealer" we refer to persons who make a business of buying nursery stock from various places and selling it again upon his own responsibility or under his own name. Whenever we learn of a tree dealer in this State we ascertain of him the names and addresses of the firms from which he procures his stock, and we then write to the State Nursery Inspectors in the respective States named and learn if the nurseries named have been inspected, and if the firms have in every way complied with the requirements of the law in their States, and if they have a certificate for selling nursery stock according to the regulations of the said State or States. Upon obtaining this information, if all is favorable, a certificate is sent from this office to the tree dealer to sell stock from

those nurseries which we have investigated and found to have certificates, but from those only. If it be found that any nursery the dealer named, in any State whatever, has not complied with the legal requirements of said State and does not have a certificate for the selling of stock in its own State, the tree dealer is refused a certificate to sell stock from that nursery.

Any tree dealer in this State should consequently be able to show his certificate from this office and any agent should have credentials signed by the nursery which he represents, and which he can show. He should also be able to show conclusive evidence that his nursery holds a certificate of inspection in the State where the stock is grown.

The following is a list of licensed tree dealers in Pennsylvania at this date:

ALLEGHENY COUNTY.

C. F. Halfast, Wilkinsburg, Pa.
H. M. Devereaux, Swissvale, Pa.
W. B. Bockstose, Castle Shannon, Pa.
L. F. Miller, 1023 Garret St., Pittsburg, Pa.
E. C. Hauser, Bellevue, Pa.
Charles Honess, Allegheny, Pa.
J. F. Zimmerman, Emsworth, Pa.
J. M. Fails, 1807 Nunetta Ave., Pittsburg, Pa.

BEAVER COUNTY.

J. C. Withrow, Vanport, Pa.
J. H. Gutermuth, Rochester, Pa.
A. E. Crouch, Rochester, Pa.

BERKS COUNTY.

Jacob H. Weand, Reading, Pa.
M. E. Smeltzer, Reading, Pa.
Alfred Dreibelbis, Reading, Pa.
L. M. Neischwender, Hamburg, Pa.

BLAIR COUNTY.

James Hopkins, Juniata, Pa.

BRADFORD COUNTY.

J. F. Gable, Athens, Pa.
Jos. E. Hamilton, R. D. No. 16, Rome, Pa.
J. P. Sibley, R. D. No. 16, Rome, Pa.

BUCKS COUNTY.

A. P. Kratz, Silver Dale, Pa.

BUTLER COUNTY.

Geo. W. Haine, R. D. No. 32, Callery, Pa.

CARBON COUNTY.

Paul Neihoff, Lehighton, Pa.
David N. Rehr, Lehighton, Pa.
L. B. Wagner, Weissport, Pa.

CHESTER COUNTY.

John Alcorn, Malvern, Pa.
F. W. Richardson, Paoli, Pa.

CLEARFIELD COUNTY.

Thos. W. Munro, DuBois, Pa.

CLINTON COUNTY.

W. W. Richie, Lock Haven, Pa.

CRAWFORD COUNTY.

J. C. Boyd, Guy's Mills, Pa.
F. M. Fleming, Cochranton, Pa.

CUMBERLAND COUNTY.

Ira A. Bigler, Camp Hill, Pa.
D. C. Rupp, Shiremanstown, Pa.
Towzer & Wolff, Carlisle, Pa.

DAUPHIN COUNTY.

A. H. Shreiner, Harrisburg, Pa.
Geo. F. Greenawalt, Hummelstown, Pa.
T. A. Woods, Harrisburg, Pa.
J. R. Snavely, Harrisburg, Pa.
J. M. Christman, Fort Hunter, Pa.

DELAWARE COUNTY.

John Wetherill, Chester, Pa.

ERIE COUNTY.

W. S. Waldo, North East, Pa.
C. E. Powell, Lundy's Lane, Pa.
W. C. Batchelor, Erie, Pa.
F. S. Powell, Lundys Lane, Pa.

FULTON COUNTY.

Lewis H. Wible, McConnellsburg, Pa.

LACKAWANNA COUNTY.

Giles L. Clark, Scranton, Pa.
A. J. Noble, Scranton, Pa.

LANCASTER COUNTY.

J. S. Holwager, Elizabethtown, Pa.

LEBANON COUNTY.

Samuel P. Moyer, Myerstown, Pa.
M. D. M. Baldorff, Myerstown, Pa.

LEHIGH COUNTY.

N. C. Beachy, Allentown, Pa.

LUZERNE COUNTY.

W. H. Lanyan, Hazleton, Pa.
H. M. Rogers, Dallas, Pa.
Geo. W. Long, Sweet Valley, Pa.

McKEAN COUNTY.

F. S. Palmer, Bradford, Pa.

MONROE COUNTY.

L. D. Eilenberger, E. Stroudsburg, Pa.

MONTGOMERY COUNTY.

John Reig, Jenkintown, Pa.
A. E. Wohlert, Merion, Pa.
Benj. Connell, Hoyt, Pa.

NORTHAMPTON COUNTY.

T. S. Headman, Seidersville, Pa.
Dominico Sebastino, Roseto, Pa.

NORTHUMBERLAND COUNTY.

H. F. Frank, Montandon, Pa.
Jos. Harris & Bro., Shamokin, Pa.

PHILADELPHIA COUNTY.

Moore & Simon, Philadelphia, Pa.
J. R. Giffen, 1826 No. Willington Street, Philadelphia, Pa.
Wm. Henry Maule, Philadelphia, Pa.
Walter P. Stokes, Philadelphia, Pa.
Henry F. Michel Co., Philadelphia, Pa.
Hosea Waterer, Philadelphia, Pa.
Johnson Seed Co., Philadelphia, Pa.
Herbert Inman, 2419 College Avenue, Philadelphia, Pa.

SCHUYLKILL COUNTY.

Walter J. Keller, Pottsville, Pa.
W. O. Snyder, Minersville, Pa.
D. H. Smith, Haas, Pa.

TIOGA COUNTY.

Arthur Edwards, Elkland, Pa.

UNION COUNTY.

J. G. Oberdorf, Mifflinburg, Pa.

WYOMING COUNTY.

Russell Bros., North Mehoopany, Pa.
A. Ross, North Mehoopany, Pa.

YORK COUNTY.

C. H. Snyder, York, Pa.
J. H. Painter, York, Pa.
Henry Everhart, Manchester, Pa.

OHIO.

Jones & Vernon, Troy, Miama county, Ohio.
Myers Bros. & Co., Wilmot, Stork County, Ohio.

HABITS OF, AND REMEDIES FOR, SAN JOSE SCALE.

For persons who have at hand our October Bulletin for 1907 a prolonged discussion of the San José Scale at this time is not necessary, but as many names and addresses have been added to our mailing list since that Bulletin was issued, it may be advisable to repeat here some of the chief points concerning the San José Scale and its remedies.

This pest is a minute insect not larger than the dot of the letter "i" in this bulletin, which attacks nearly all varieties of fruit trees and much of the ornamental shrubbery, such as Japan quince, osage orange, mountain ash, currant bushes and other woody plants, inserting through their bark its long proboscis and injecting into them a poisonous saliva, also sucking their sap for its own sustenance. The poisoning of the trees by the San José Scale is the most serious feature. This is to be compared to the injury inflicted on the human being by attacks of great numbers of mosquitoes.

The San José Scale does not lay eggs, but reproduces by bearing living young, beginning in the southern parts of this State during

the early part of June and continuing in some years until the first of December. Several young are born each day and the multiplication is so rapid that it is estimated and published by the U. S. Department of Agriculture that one San José Scale can be the ancestor of three billion two hundred and sixteen million eighty thousand four hundred (3,216,080,400) in one season.

During the first day or two of the life of a San José Scale it crawls about freely over the bark hunting for a place to fix itself insert its beak, and commence to feed. We have known it to travel as far as six feet from the parent scale, or to fix on the bark close enough to be in contact with the parent. The scale itself commences to form as a water-proof waxy substance that comes through pores of the skin and is first white, then becomes darker until it is quite dark. It is of greyish color and sometimes almost black. It is perfectly circular, with a tip or point in the centre and a little groove or ditch around the point. These characters are visible only under a good microscope, but are distinguishing features that are sought by our inspectors in determining this pest from among the many other scale insects that may be found upon trees or shrubs.

The pest is carried from place to place only when it is young and free moving or when it is fixed upon wood that is going to grow again. In other words, after it has once fixed on a piece of wood, it can never free itself and can never be scraped off and live, and unless this wood continue to live as a part of the tree or as a graft, scion, or cutting, the scale will perish. This means that the trimmings of trees do not need to be burned in order to get rid of this pest, as in burning the trimmings of pear blight and fire blight, for example, because the scale will perish upon the branches after they are cut off. It is, of course, upon nursery stock mostly, but also upon cuttings and grafts or buds, that the scale is carried into any new region.

It is in the young and free-moving stage that the scale is spread for short distances from an infested orchard to a neighboring one, or from tree to tree, by various means, such as upon the feet of birds, upon the feet or fur of domesticated animals, upon the clothing of or tools of workmen, upon larger insects that rest in the infested trees and the fly to others, upon larger animals, such as cattle walking beneath the branches and carrying the pests that may drop upon them, or by the wind itself blowing them through the air like fine grains of sand or carrying leaves or twigs upon which the free young may cling. Any agency whatever that will carry small particles, as small as very fine grains of sawdust or corn meal, from one tree to another, would be such as could disseminate

or spread the San José Scale. Although the spreading of young scale takes place only when it is young and free-moving, it must be remembered that many young are constantly appearing throughout the entire summer season, and consequently there is no time during a day or night when it would not be possible for the young scale to be carried from an infested tree to one that was clean. There is no means of preventing its spread other than spraying to reduce its number, thus reducing the chances of its being carried, and destroy the English sparrows, which are the chief agents in spreading it.

Enemies.—There are several enemies of the San José Scale, such as the larvæ of the Lace-wing Flies, the Beetles known as Lady Bugs, Lady Beetles, or Lady Birds, of which there are several species, and also such birds as Chickadees and others of the very small insect-eating species. In China this pest is held in check by its native enemies there, which are chiefly Lady Beetles of a species not found in this country. An effort was made to introduce these beneficial insects into America, but it did not succeed, owing to the parasites which in turn destroyed it.

Remedies.—While the scale in sects are young and moving they are very delicate and as easily destroyed as plant lice. Mild contact insecticides, such as whale oil soap, one pound in six gallons of water, or common laundry soap, one pound in three gallons of water, or common soft soap, same proportions, of a strong decoction of tobacco, or kerosene emulsion, eight per cent. oil sprayed over them will kill them. This does not kill the parents or those that are sufficiently mature to be covered by the protecting scale. Our experiments have shown that it takes more than fourteen sprayings, repeated at intervals of two days each, to kill all the young as they appear and yet continue the work until the reproductive ability of the parent is exhausted. Consequently, it is out of the question to think of spraying for the San José Scale during the summer time when the trees are in leaf, and having good results, without using materials so strong as to destroy the foliage and consequently be in great danger of seriously injuring the trees or shrubs that are to be protected.

The proper time for applying remedies for the San José Scale is when the leaves are off the trees or when the trees are dormant. Fall spraying is advisable, as it gives time to spray when the ground is solid, and the fruit grower may have more time than in the early spring when he may wish to be at other work. Spraying at any time during the winter is to be recommended, and will give excellent results. This may be done during any day when it is so warm that the spray material will not freeze before it dries

upon the branches. Trees should not be sprayed when they are wet nor when they are covered by ice. The best possible time for spraying for San José Scale is in the early spring just before the buds start to swell. This is also the time for spraying to kill plant lice and many other insects, as well as most fungous diseases. One spraying at this time with the boiled Lime-sulphur Wash will prevent the appearance of the peach leaf curl during the coming summer. It is strongly recommended to spray badly infested orchards both fall and spring, doing a thorough job, and thus getting control of the pests. After this is effected, spraying once every two years will be sufficient to keep the scale in control, but persons who see the decided beneficial results of the use of the boiled Lime-sulphur Wash on their peach and plum trees will spray every spring, regardless of the presence or absence or reduced numbers of the San José Scale.

Material to Use.—Many kinds of materials are recommended more or less for the San José Scale, but among all of these it is definitely proven in nearly all of the States of the Union, as well as in other Countries, that up to this time that is nothing so cheap nor effective, and in every way so satisfactory, as the boiled Lime-sulphur Wash, thoroughly applied. Oils are being strongly recommended, especially by the manufacturers and agents, who are endeavoring to make money by selling the same to fruit growers, but the great trouble with the oils is the fact that when they are used strong enough to give proper results in killing the scale, there is very great liability of injury to the trees by the same. As this injury is accumulative, that which is done one year remaining and being augmented by an application of the same material another year, it may prove quite disastrous in the end. This applies as well to the proprietary substances or so-called soluble oils as to the home-made oil emulsions and oil mixtures.

The Soluble Oils.—This name is given to certain commercial insecticides or preparations among which are those named "Scalecide," "Kill-o-Scale" and "Targent Brand Scale Destroyer," the basis of which is crude petroleum treated with an emulsifier composed of carbolic acid, resin and fish oil or some other animal or vegetable oil. Some great objections to these commercial insecticides is (1) their extreme cost, in most cases costing at least ten times as much as the Lime-sulphur Wash, and also (2) in the lack of fungicidal quality, which the sulphur compounds possess, as well as (3) liability of injury to the trees when used too strong, (4) danger in not killing the scale when not used strong enough, and (5) the further fact that they do not leave a mark or visible stain on the trees to show the operator any spots that may accidentally

have been missed during the first spraying, in order that he can reach these places and cover them during the second or re-touching spraying, which should always be given. Manufacturers and agents of such oils are making a great mistake in recommending them to be used as dilute as one part of the oil to twenty parts of water to kill the San José Scale. We have tested them and find that they are not reliable at this proportion. They would be much more liable to kill the scale if used in the proportion of one to twelve, but this is getting near the point of danger for certain trees, especially the peach and plum. On pear trees oils can be used with good advantage.

Lime-sulphur Compounds.—The Lime-sulphur Compounds, made by boiling Lime and Sulphur together for at least an hour, are by all means the best and also cheapest remedies to use for the San José Scale. For this purpose use either the Flowers or Flour of Sulphur, boiled for at least one hour. The formula is as follows:

Calcium Lime, 22 pounds.

Ground or Powdered Sulphur, 17 pounds.

Water to boil one hour.

Water added to make 50 gallons.

It does not make any difference which material is put into the water first, but we make this by mixing the Sulphur into a paste with water in a bucket and dumping this upon the dry Lime in the kettle, adding just enough water to slake the Lime while we are starting the fire. As soon as it is slaked, the Lime and Sulphur are stirred together and enough water added to boil an hour, and it is boiled a full hour.

The next point is the most important of all in doing satisfactory work, and this is the straining. Strain it through a brass wire cloth as fine as about thirty meshes to the inch. The best strainer for this purpose, which we have seen, is a large funnel with this cloth set in it in the form of a cone, with the point upward inside the funnel. Such wire cloth can be bought of Hall and Carpenter, Tin Plate Men, Philadelphia, or of George C. Fager and Sons, Harrisburg, Pa. The last-named persons make these conical strainers for about one dollar each. Any person spraying with any mixture or compound of lime can not well be without a conical strainer. If the Lime is well strained it will go through any spray nozzle without clogging, and this is why the straining is a feature of such importance. It prevents the clogging of nozzles and the bursting of hose. Have the interior of the spray tank well cleaned so that no particles of dirt may get into the nozzles from this source, and strain the boiled liquid into the tank and add enough water to make the entire solution up to fifty gallons. Whatever solid in-

gredients may be left may either be put back in the barrel again or may be put around the base of peach trees to prevent peach tree borers.

Apparatus.—It does not make much difference what kind of spray pump is used so it is one that gives a strong even pressure without working too hard. It is important to use a lead of at least twelve and one-half feet of hose, with an extension rod six or eight feet in length. This extension rod can easily be made of ordinary gas pipe with threads cut at one end to fit the hose and at the other end to carry the nozzles. If it be desirable to take it apart for convenient carrying, the extension rod can be cut for the purpose and jointed in the middle, making two sections, each three or four feet in length. On the further end of the extension rod there should be an eighth-turn, or the rod itself should be bent slightly at the end. It should carry a "Y" attachment for at least two nozzles of the "Vermorel" type. The nozzle known as the "New Mistry" is larger and throws a larger spray, saves time, and clogs less readily than any other we have used. No person can afford the time to attempt to spray his trees with only one nozzle on the end of the hose or extension rod. Use at least two or three in the cluster. In general, the barrel spray pump will be found most advisable and serviceable for general operations. We have found most satisfactory results by using a comparatively small barrel sprayer mounted on wheels in the manner that swill barrels are often carried.

Before commencing to spray the operator should put vaseline or lard on the exposed parts of his hands, face and neck, or should protect himself so that the liquid will not come in contact with the exposed portion of his skin; and he should also cover his horses with blankets, so that they will not be soaked with the liquid. By using a hose long enough it is possible always to keep the team and operator on the side of the tree toward the wind, and thus prevent evil effects from the spray blowing over them. When the wind is so variable as to carry the spray back over the team unsatisfactory results will come from attempting the work. It is possible to spray the trees from only one side when a fairly strong wind is blowing and do good work as far as that side is concerned. but it is very important to spray it again from the opposite side after the wind has changed or stopped. Thoroughness of application is one of the most important features of spraying for scale insects. The trees should be thoroughly covered from the tips of the furthest branches to the base of the trunk. There should not be one particle of the bark left dark or unsprayed. For this reason after the sprayed trees are dry enough to let the operator

see what spots he has missed he should go over them again either then or later, and give a retouching spray.

Time of Spraying.—Spraying for San José Scale and similar pests can be done at any time of year when the trees are not in leaf. In our practical and experimental work we have found no injury whatever to the leaves from the Lime-sulphur Mixture when applied at any time of year when dormant or when the leaves are off, as it has been equally efficient in killing the scale in fall, winter and spring. However, when the salt was added to the mixture some injury was experienced to the leaves of peach trees by the fall spraying. The best time to spray is in the spring when the buds are swelling and just before they burst. The material applied at this time will be protected from the washing effects of rain as the leaves will soon appear and cover it and it will adhere all summer and be beneficial in preventing the fixing of the few young scale insects that may come from any old ones that may have been missed or not covered by the spray liquid. During the summer time or while the leaves are present no insecticide can be applied strong enough to kill the fixed San José Scale without also destroying the leaves and thus proving objectionable.

How often should we spray? This question is often asked and the reply depends upon the kinds of pests for which we are spraying, the abundance of infestation, the kinds of trees and the time of year. For example, we should spray peach and plum trees with the Lime-sulphur Wash every spring just before the buds burst, whether San José Scale be present or not for the reason that it is such a tonic to the trees and cleans up fungus disease spores as well as other insects that may be present. Also if trees were badly infested and were sprayed in the fall only, they should be again sprayed in the spring. If this work be thoroughly done there will be no need of spraying again as far as the scale alone is concerned within two or possibly three years from the date of the last spraying, but it may be necessary to spray with other materials for other pests, such as the Codling Moth and plant diseases.

Apparatus.—The kind of apparatus to use depends upon the size of the trees and the number to be treated. Much failure is due to the use of small and worthless outfits. In general nothing will give satisfactory results that is smaller than a barrel sprayer mounted upon at least a small sized barrel. For small orchards and garden spraying we like a half barrel or small sized barrel mounted between two wheels pushed by hand like a push cart. For larger orchard work we prefer a force pump, with an air chamber, mounted in a barrel of full size, hauled in a cart or wagon. This is large enough and heavy enough to spray trees of any size

by merely using hose long enough to reach their tops. For larger orchards where there is much spraying to be done we recommend power spraying apparatus. The power may be gas pressure, compressed air, gasolene or steam. The geared power apparatus, which compresses air into the tank by gearing attached to the wheels of the wagon, will not prove satisfactory for medium to large sized orchard trees, although it may be all right for spraying small trees and field crops. The trouble with geared apparatus is that the power runs down quickly when the outfit stops and stands still to spray a large tree.

To reach tall trees and spray them properly it is not so much a question of extreme power as of hose long enough and other preparations to get the nozzles to the tops of the trees and do thorough work. One operator should stand on an elevated platform constructed of well braced rafter lumber in the wagon bed and should be provided with an extension rod of eight or ten feet in length attached to the end of a long hose, and he should likewise have ladders at hand by which he could climb well to the tops of the trees and spray them thoroughly. We wish to emphasize the point made in the Report of the General Fruit Committee of the State Horticultural Society at the recent Annual Meeting in which it was said that the principal cause of failure or poor results from spraying in this State is lack of thoroughness in the application of the material rather than any other cause.

Protection of Operator.—It must be remembered that materials that will kill such hardy pests as scale insects must necessarily be objectionable to the operator and for this reason he should cover the exposed parts of his skin with vaseline and wear cheap leather gloves made impervious to liquid by dropping into melted tallow. Horses should be blanketed and team and operator should keep on the windward side of trees to prevent the spray liquid from covering them.

COMMERCIAL INSECTICIDES AND HOME-MADE SOLUBLE OIL.

There never was such an effort to place commercial insecticides on the market in this State as at the present time. The chief arguments for the commercial insecticides have been ease of preparation and easy working of apparatus. The chief points against them have been (a) excessive cost; (b) the danger of not killing the scale insects if used too dilute; (c) the danger of injuring or killing the trees if used too strong, and (d) the important fact that with most of them no stain is made on the bark to indicate where the spots were missed and must be retouched.

Among the commercial insecticides which have recently been popular are chiefly the so-called soluble oils. They have not acted as fungicides, notwithstanding what agents and manufacturers claim for them, and besides this fact their cost has been so high as to be prohibitive, that they did not give general satisfaction. From all over our State, and from every State in the Union, the reports come more emphatic than ever before that the best, cheapest, surest and most desirable material to use for Scale Insects is the boiled Lime-sulfur Wash. Fortunately, the preparation of this is now assuming a commercial aspect, and good and reliable concentrated Lime-sulfur Wash is now being placed upon the market, which according to results of our latest tests, will prove fully as meritorious in all points as the homemade lime-sulfur solution, with the one exceptional feature of the slightly additional cost.

Much has recently been said concerning the homemade preparation of the soluble oils. This can be done at a cost of less than one-half the commercial products, and according to our recent orchard tests and experiments, they apparently give as good results as any of the commercial insecticides of their class. To make them it is necessary to make an "emulsifier" or a liquid which is to be stirred into the stock solution of oils to make the stock or concentrated solution, which in turn is to be diluted with water or dissolved in water at the time of spraying.

The emulsifier is made as follows: (From Del. and Conn. Bulletins.)

Crude Carbolic Acid (100 per cent), 2 quarts.

Good straw-colored Fish Oil (not veterinarian), 2½ quarts.

Caustic Potash (granulated) or stick Potash (75 per cent. pure), 1 pound.

Mix these together and heat in a covered iron kettle to three hundred degrees Fahr. (300° Fahr.) Cover the fire, or remove the kettle from it, and immediately add Kerosene, three and one-half (3½) quarts, and water five (5) quarts. Stir well. This is the liquid called the "emulsifier." The commercial caustic potash, such as is used for making soap will not do, neither will caustic soda take its place. Also the low grade of fish oil, known as veterinarian fish oil, should be avoided. The only apparatus necessary is an iron kettle covered with boards or lid and a thermometer graduated to three hundred degrees Fahr. In fifteen minutes after placing it on a good fire the desired heat of this temperature can be reached.

Make the soluble oil or stock mixture in its concentrated form by stirring together the following:

Emulsifier, 8 parts; Crude Petroleum, 18 parts; Resin Oil, 4 parts; Water, 1 part.

This can be made at any time, as upon rainy days or during bad or cold weather, and can be kept in this concentrated form until

wanted. For use stir one part of this homemade soluable oil into sixteen parts of water. The cost of the stock mixture of oil after rendered soluble is about sixteen or eighteen cents per gallon, making the cost of the dilute mixture, when ready to apply to the trees, about one cent per gallon.

SPECIMENS RECEIVED DURING DECEMBER, 1907.

Number.	Specimen.	Date—Dec., 1907.	Name and Address.
	Insects.		
11196	Oyster-shell Scale,	5	J. C. Dolen, Mauch Chunk.
11199	Oyster-shell Scale,	5	R. Shepherd, Dingmans Ferry.
11200	San José Scale,	5	M. R. Longacers, Millerstown.
11201	San José Scale,	5	R. L. Jackson, McConnellsburg.
11204	Cynip Gall (Diastrophus cuscuiformis),	10	J. C. Hoffman, York.
11205	White Fly (Aleurodes sp.),	10	Hon. S. B. Elliott, Harrisburg.
11206	(a) San José Scale, (b) Scurfy Scale,	10	Robt. Burleigh, New Stanton.
11214	Scurfy Scale,	13	G. W. T. Warburton, Granville Summit.
11215	Oyster-shell Scale,	15	H. W. Robinson, Shermansdale.
11216	San José Scale,	15	E. K. McConkey, York.
11220	San José Scale,	16	N. J. Spencer, Honesdale.
11221	Oyster-shell Scale,	16	J. S. Campbell, Cheswick.
11222	San José Scale,	16	M. L. Reigel, Linglestown.
11223	Podurids,	18	O. P. Warfel, Rohres.
11224	Aphids,	18	P. C. Laubach, Benton.
11226	(a) Greenhouse Scale (Hemichionaspis aspidistrae), (b) Hemisphaerical scale (Saissetia hemispaerica),	18	Mrs. M. Criswell, Vandergrift.
11229	White Pine Chermes (Chermes pinicorticis),	28	I. C. Williams, Harrisburg.
11230	Fungus Beetle (Boletotherus bifurcus),	28	N. E. Shimmel, Wallaceton.
11232	Collection of Mounted Ants,	27	W. M. Wheller, Amherst, Mass.
11233	Collection of Insects,	30	J. C. Campbell, Cheswick.
11234	(a) San José Scale, (b) Scurfy Scale,	30	H. L. Patterson, Reading.
11238	(a) San José Scale,	31	W. R. Simmen, Pittston.
	Invertebrates Not Insects.		
11198	Red Mites,	5	E. P. Miller, Altoona.
11206	(c) Red Mites,	10	R. Burleigh, New Stanton.
11207	Red Mites,	10	P. H. Peffer, Harmony.
11211	Red Mites,	10	H. W. Anderson, Stewartstown.
11225	Mite,	18	C. S. Anderson, Harrisburg.
11234	(c) Mites,	30	H. L. Patterson, Reading.
11238	(b) Mites,	31	W. R. Simmen, Pittston.
	Reptiles and Batrachians.		
11194	Jeffersonian Salamander (Amblystoma jeffersonianum),	5	R. C. Beaver, Greenville.
11219	Common Garter Snake,	16	R. W. Wehrle, Indiana.
11231	Python,	30	J. Hope, Philadelphia.
11236	2 Blacksnakes,	31	R. Templeton & Son, Ulster.
11237	Blowing Viper,	31	M. F. Doyle, McConnellsburg.
	Birds and Mammals.		
11193	Wood Rat (Neotoma pennsylvanica),	5	H. P. Swope, Huntingdon.
11195	Brunnich's Murre (Uria lomvia),	5	W. L. Biles, Wyalusing.
11203	Sharp-shined Hawk (Accipiter velox),	10	L. S. Bean, Emlenton.
11212	Red-shouldered Hawk (Buteo lineatus),	13	J. Mell, Jr., Richland.
11235	Wood Rat,	31	Dr. H. D. Moore, New Lexington.

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THE

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H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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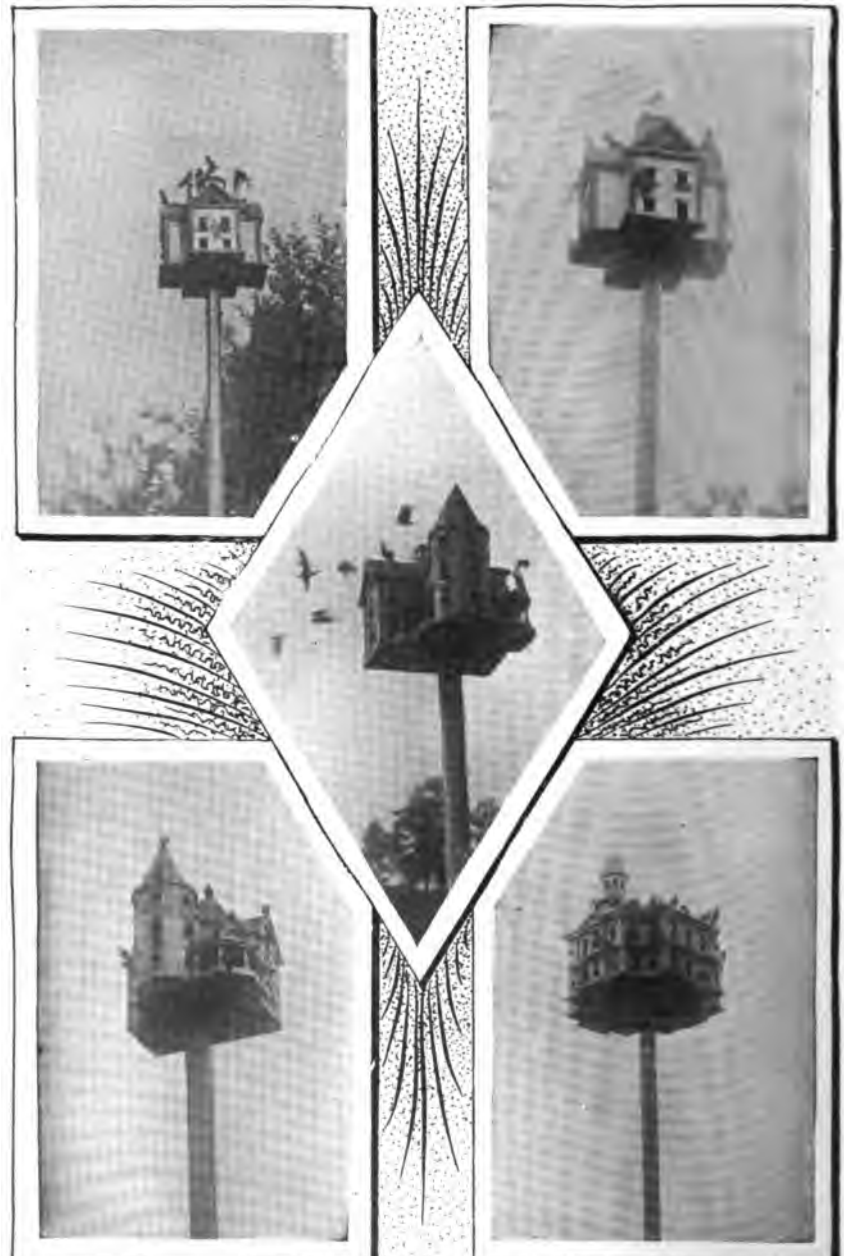


Plate XXXV. Houses No. 1, 2 and 3 from "The Story of a Martin Colony," from photographs taken by the author, J. Warren Jacobs, Waynesburg, Pa. The two upper pictures were taken while the birds were collecting on the house. The central picture is from a snapshot as the birds took flight from the house. The lower pictures are from photos taken while a number of birds were resting on the houses. These show the ordinary scenes while the young are being coaxed out of their respective homes by their parents.

Plate XXXVI. (a) House No. 4, containing sixty-six nest rooms. From a photograph taken July 16, 1907 and reproduced by Mr. J. Warren Jacobs, in his second edition of "The Story of a Martin Colony."

(b) Martin Houses Nos. 3 and 4, in position, showing their surroundings. From the second edition of "The Story of a Martin Colony." From photograph taken June 15, 1907.

Plate XXXVII. Bird Boxes made and erected by the pupils of the Upsala Street School, Worcester, Mass. All the children are putting up bird houses.

From Nature Study Leaflet, "Our Common Birds. Suggestions for the Study of Their Life and Work." Biology Series No. 2, by C. F. Hodge, Ph. D., Clarke University, Worcester, Mass. Plate kindly loaned by Prof. Hodge.

Doolin Valleys, and from the valleys coming into the Ohio from the opposite side of the river. When the birds reached the town which was at about dusk, they would circle around before settling on the wires.

From the foregoing it would seem that our beloved House Martin is in no immediate danger of extinction, notwithstanding bad weather conditions, during the past four years, have affected them, at nesting time, all over Eastern United States, and in some sections, especially the New England States, where they once thrived, they are now almost extinct.

My own colony, which increased steadily from 1896, until about eighty pairs nested in 1904, and which is provided with the best accommodations, and afforded the best protection from persecutions by man, cats and sparrows, has been reduced one-half, on two occasions by disastrous weather conditions. In 1905 nearly 100 pairs had collected at my bird houses. Several pairs went elsewhere at nest-building time, and cold, damp weather at frequent intervals so interrupted and retarded the remaining birds in their work of nest-building that their numbers continued to decrease until barely 40 broods were raised.

Very much the same fate befell them in 1906, but there were on July 8 twenty-three occupied nests in house No. 5, and twelve or thirteen in each No. 3 and No. 4. All young which hatched at my colonies, and at all others in and near this town, that year, thrived well, and a good increase over the previous year was noticeable.

In the latter half of March, 1907, this section experienced unusually fine warm spring weather which brought many Martins to the various bird houses in other parts of town; but, strange to say, none had yet arrived at my premises until April 3, and this one was killed by the unprecedented April freeze, which continued unceasingly until about the 19th of the month. During this period, all the Martins—at least a hundred—which had arrived in this locality, perished from cold and starvation. It was about the last of April before the Martins again began to arrive. After May first they had a fair season, and success with their broods, but the annual production did not show an increase over the previous year.

With the coming of spring these birds will again be moving north to their nesting boxes, and with fair weather and no mishaps, this year will see an increase in the nesting pairs.

FOOD. The Purple Martin is one of most beneficial of birds, living entirely upon winged insects thousands of these pests are captured daily, in the vicinity of a thriving colony, for the menu of each brood. The further fact that the young remain in the nest rooms about

four weeks, to be fed by their parents, increases this bird's value as an insect destroyer.

In cleaning out my bird houses, after the broods have departed, I have examined the contents of the debris left behind and find from a fourth to a whole pint of undigested remains of insects. A predominance in this dirt is the hard wing-shell or case of a small Black Beetle we see in the air in the morning and evening, and sometimes throughout the day. In a teaspoonful of this dirt there is from 200 to 500 of these little wing coverings, and these, too, form only a small part of the debris left in the nest-room—the bulk being undeterminable, and on the whole represents only a portion of the excrement of the young, much of it being carried away by the parent birds.

It is just such insects as these that the birds are capturing when we see them soaring, wheeling, darting and gliding to and fro, high in air. They spend about sixteen hours, every day, in search of food. It undoubtedly requires hundreds of thousands—if not millions—of insects to feed an ordinary brood of Martins and sustain them and their parents until the time arrives, late in August, for them to take their departure.

Think of what this means to a community, and pause to realize the service rendered mankind by only one species of insectivorous birds.

In the summer of 1907, there was nesting in and around the town of Waynesburg, between 200 and 250 pairs of Purple Martins. The writer made several visits to the various colonies and found fair-sized broods flourishing. Three or four seemed to be the rule. Now here was about 800 young, which hatched between June first and fifteenth, and remained with us until after the middle of August—over two months—and between 400 and 500 parent birds who remained nearly five months. Over 1,200 insect-hunters, all to live and thrive on these most destructive pests. To express the number of insects consumed by the Waynesburg colonies alone would demand a long line of figures; and from what I am led to believe, after years of observation and examination of the debris from the nest rooms, it would require the filling of a bushel measure, at least a few times, to meet the demand of a season's nesting at my own colonies.

DISTRIBUTION.

There are only a few sections of Pennsylvania where the Martin cannot thrive——I refer to the higher mountain ranges. The bird really belongs to, or is most abundant in the Carolinian Life Zone, sections of which touch our State on the southeastern and southwestern corners, but it is also adapted to and is common in the Transition or Alleghenian Life Zone, which covers

most of this Commonwealth. The higher mountain ranges are in the lower Canadian Life Zone of the Boreal Region, and out of the common range of the Purple Martin.

There may be wide expanse of territory, well adapted to the Martin's habits, in which it does not breed, because no inducements have been advanced for its consideration, or if such have been offered in suitable localities and not accepted by the birds, it is probably because the new house was far from any breeding colony, where there is an annual overflow of young birds to seek new quarters upon their return from the South.

HABITS.

The Martins, both old and young, return to the house of their nativity as long as it will accommodate them. When the young, of the previous year, return in such force as to overcrowd the old home, they are fought out by those already in possession, and retreat to new quarters, which will be selected near the old home if such exists. Therefore, the hope of establishing a new colony, depends, chiefly, upon an overflow, or a supply of surplus young birds from a neighboring colony, or discontented adults from neglected or dilapidated bird boxes. I know of colonies in this county which are five miles apart. It would be an easy matter for residents living between these points to establish colonies, and many times this distance from any known colony should be no discouragement to the person who is willing to make an effort to establish the birds.

These birds travel over wide expanse in quest of food. I have followed my birds three miles from their home boxes when they were procuring food for their young; and during their summer stay in this region, they, no doubt, roam over the whole county.

Where the country is of similar nature in climate and is not traversed by mountains of high altitudes, I am of the opinion that new colonies may be started within a radius of twenty-five miles from a well established colony, especially if there be an overflow or surplus of young birds, or if the original boxes be allowed to become dilapidated, or the colony be neglected by allowing the Sparrows to fill the nest rooms with rubbish.

MARTIN HOUSES

In the February, 1904, issue of "The Monthly Bulletin of the Division of Zoology" I gave an extended article on the construction of bird houses for the Martins, and will here state briefly that the compartments should be 6x6x6 inches square, or a little larger,—not over 6x8x7 inches. For each room, there should be only one opening, 2¼ inches square, on a level with the floor one inch above it, and a small perch at the bottom of each entrance. The house should be well painted (I paint all my

boxes white, with colored trimmings), and joints in the roof should be tinned to keep out the rain. A few dollars will pay for all materials for a neat, serviceable box with several rooms, which can be constructed during idle hours, and the result enjoyed throughout the summer.

The height of the house above the ground should be between twelve and fifteen feet in quiet premises; and higher, if in a very public place, or where children use the lawn for a play ground. When I first established my Martin colony I had no children, but since that event I have been blessed with a small "colony" of my own kind, who romp and play over the lawn which encircles bird house No. 3. This box used to be a favorite with the birds, but I noticed a decrease in the number of its occupants, especially in the years when the birds were reduced by the elements, leaving surplus rooms in the other houses. Those remaining seemed more timid than formerly, and as I had made a two-foot fill in this part of the lawn, I concluded the bird box should be higher. Accordingly, last spring, I raised it to 16½ feet above the ground, and it was better patronized by the birds.

My friend, Mr. J. M. Walker, of New Bethlehem, Pa., has sent me a photograph of his bird home, which was well patronized by the Martins the past season. It consists of a cluster of four boxes surrounding the top of a 50-foot pole, with a roosting shed eight feet long above them. Under the protecting roof of this shed, the old birds gather their broods to spend the night, after they are strong enough to leave their respective nest rooms. He writes me that his birds had a very successful year in their remarkably high aerial castle.

After your efforts to establish these birds once results in success, you are assured of their continued return each year, as long as you give them proper attention and protection, and as long as the birds do not meet death in some way.

HOW TO GET THE BIRDS?

That is the question. You must first build your bird house and experiment by erecting it in a conspicuous place, and wait for the birds. Keep out the sparrows, and if no Martins come the first year, try a second or a third time. In new territory the box should be up early in April, to attract passing migrants, but near old colonies, the latter part of that month is soon enough to put up a box.

If you are interested, it is well worth an effort to try to establish the birds, and a man or boy with two good eyes and strong

active arms, has plenty of leisure time to build a bird house. My friend, Mr. John T. Timmons, of Cadiz, Ohio, is blind, but he built an elaborate bird house for his residence grounds, that he might hear these fine birds, although he could not see them. He was successful, and writes me of the great pleasure he has of listening to the babbling warble of the birds.

In conclusion, I wish to give the results of my experiments in re-establishing these birds in communities far from my breeding colonies.

Several years since, I sent to a gentleman in Elmira, N. Y., a pair of old birds which he liberated, but not according to my instructions, which might not have succeeded anyway. He never saw the birds again.

For several years I sent Martins' eggs to Chas. H. Kingsbury, Barnard, N. Y., to be hatched in Barn Swallows' nests. In nearly every instance the eggs hatched, but accidents befell the young birds. At another time I sent eggs to Wm. C. Horton, Brattleboro, Vermont, to be hatched in the nests of Tree Swallows, which had taken possession of his deserted Martin house. These eggs hatched, but after two weeks' constant care by the foster parents, Mr. Horton found something had killed all the young birds and carried three of them away.

Mr. Kingsbury made another effort to establish the birds last year, by raising by hand, six young birds I sent him from my own and Mr. Reese's colonies. He stated that it was wonderful the number of insects these youngsters devoured; one of his farm hands occupying his entire time in tending their wants. Two of the birds died, one escaped, and the remaining three were seen with a flock of Swallows, some days after they were liberated. He may see the return of these birds with the coming spring.

The White Race is not wholly responsible for the House Martin evolving in its nesting habits from the natural cavities in trees and cliffs to the elegant home-like nesting boxes with which it is now provided. True, the white man's high state of civilization and culture has perfected the scheme, but to the American Indian, who loved and honored this bird, must the credit be given for first providing rudely constructed receptacles for its accommodation.

Waynesburg, Pa., February, 1908.

THE STORY OF JOHN STOUT.

In the city of ———, where the writer was supervisor of Nature Study, there was an ungraded school in connection with the public

school system. Into this ungraded room were placed all of the very slow children and also the very bad or supposedly incorrigible ones. To keep the boys occupied they were given more manual training than was assigned to the other pupils, and in fact they were in the carpenter shop during the greater part of every afternoon. They naturally desired to make things and become doers by doing, rather than merely to saw and plane boards. They instinctively recognized the fact that sawing and planing and pounding amounts to little unless it be for some definite objective purpose. These boys delighted in making bird boxes, and under the direction of the writer they constructed several, vieing with one another in modifications of architecture and fancy trimmings. Many of these boxes were but plain structures with a hole near the top of each of sufficient size to admit the entrance of the bird, but at the same time permit it to defend itself against intruders.

It was recommended that the boxes be placed in the yards, gardens or lawns, and that the boys make observations as to what species of birds would inhabit them, dates when the birds came, which of the two (male or the female) appeared to be the ruling factor in making choice of nesting box, how soon after selecting a nesting site they commenced to carrying nesting materials, what materials they first carried or how they commenced the nest, the final material to be taken in, when the eggs were laid, their number, size and color, when incubation or sitting commenced, when the eggs were hatched, the food carried to the young, the care given the babies, length of time they remained in the nest, efforts of the old bird to teach the young to fly or sing (if such were made), enemies of the birds that might appear, their actions toward other birds, and such other points as could be observed and recorded.

There was a definite purpose in the mind of the writer in doing this and in thus directing the boys to become thoughtful observers of Nature. On a bright Saturday afternoon a few weeks previous to the time of making the bird boxes the writer had traced this crowd of boys along a valley road, through the woods and along the lake by a path of death and destruction which they had left behind them. Dead and crushed butterflies were seen, snakes lay bleeding in the road, and turtles with their shells broken, but the animals, not yet dead, lay in the cold water at the shore of the lake. All were to be seen telling the story of thoughtless and useless slaughter by a crowd of boys who were out seeking something to do, and were already starting on the downward course by their thoughtless attitude toward Nature, and in fact by their cruelty in the destruction of Nature's creatures of which they knew so little. These boys did not need lectures on cruelty to animals,

nor was their reformation to be brought about by severe floggings. They were boys full of the exuberance of life, and like many boys under such circumstances they were simply taking it upon themselves to exhibit their superiority over the lowly creatures about them. However, such a start is dangerous and should be checked in the right manner. We should commence by implanting into their fertile brains the seeds of thoughtfulness toward Nature's creatures, and kindness and loving care for them. Instead of calling their attention to their thoughtless, cruel deeds, they were induced to make bird boxes for nests for their feathered friends and to put up these boxes in such places as they could find convenient.

The nesting boxes were constructed and duly put in place. After a time reports commenced to come concerning the actions of the birds visiting them. One boy reported a combat between Chickadees and Bluebirds attempting to use the same box. Several persons reported the English Sparrow having appropriated the new quarters. Others reported that they would be obliged to hang out a sign, "TO LET," in order to attract the attention of the birds and cause their works of art to be no longer ignored.

Among the boys giving enthusiastic reports was little John Stout, who came with eager face and bright eyes one morning, saying, "Oh, do you know when I took my bird box home the other day there was no place to put it except on the post that mamma ties her clothes line to, in the back yard, and so I nailed it up on top of the post, and yesterday two little Jennie Wrens commenced to build a nest in it, and what do you think they used for the nest? Nothing but sticks! Wasn't that funny? I would have thought they would be using feathers and nice soft stuff of that kind, like the English Sparrows do. They carried in little sticks, and sometimes they got crooked ones, and sometimes forked ones that wouldn't go into the hole and then it was fun to see them push and tug and pull and work and turn the stick to make it go in, and when they would find out that they could not get it in, they would drop it and then look at it as though they were disgusted, and they were so busy building their nest they did not seem to see me and I could get as close to them as I am to you, and they did not seem to care for me nor to be afraid of me at all. My! but it was fun to watch the old papa bird and the old mamma bird, both working at it like as if they were really in earnest about getting their new home ready, and every once in a while they would fly to the clothes line and sing a fine little song. You bet I won't let anybody hurt them birds nor throw a stone at them, for they are going to live in our back yard there and we're going to be friends."

Thus had the seeds of thoughtfulness and kindness germinated. The boy's heart was touched, and his whole nature was changed in its attitude toward life through the realization that he and the birds could be "friends." Such a recital should be an inspiration to any teacher or parent. This was the beginning in the turn that should be desired by those who love the boy. From that time he became interested in observing other birds and other living creatures, and he became a member of "The Band of Mercy," whose purpose was to protect all creatures and advance the cause of humanity by the kind treatment of all things. He developed into a good and thoughtful boy through doing acts of kindness. Since this story is true it may come under his eyes, and he will count its publication no breach of the friendship and confidence that existed between us, because he and scores of others in the same city know that this is but one example of many of similar nature that resulted from the making of bird boxes and the study of birds.

This subject has its ethical value, which is far more than its economic or financial importance. The former is the side that should appeal mostly to parents and teachers in any country. If it be necessary to emphasize the financial importance of birds in destroying pests that save property this can well be done as a justification for giving a little time and effort to bird study and the construction and erection of bird boxes.

H. A. S.

REPORT OF THE ORNITHOLOGIST OF THE STATE BOARD OF AGRICULTURE.

By H. A. Surface, *State Zoologist.*

During the past year the correspondence by your ornithologist, concerning birds, which was directly traceable to his position with this Honorable Board, has not been very great, but the correspondence and receipts of specimens of birds in his office of Economic Zoologist has been considerable and worthy of note here. The list of specials of which specimens were received or inquiries made during the year 1907 is as follows:

American Bittern—2 specimens.
American Goldfinch or Thistle Bird—1 specimen.
American Goshawk or Northern Hen Hawk. Several specimens received last

fall and before that time practically none received. This shows there was then a flight of them to the South.

Barn Owl—1 specimen.
Brunnich's Murre—1 specimen.
Birds—Notes on Arrivals. Observations. How to Preserve Birds. Foreigners shooting birds. Not killed by spray liquids. Fall migrations.
Blackbirds, Injuring English Walnuts. How to get rid of Blackbirds.
Bluebirds—4 specimens.
Blue Heron—2 specimens.
Bluejays—4 specimens.
Broad-winged Hawk—1 specimen.
Canary—1 specimen.
Carolina Rail—1 specimen.
Catbird—2 specimens.
Cedar Bird—1 specimen.
Cedar Waxwing—3 specimens.
Chickadee—1 specimen.
Chipping Sparrow—3 specimens.
Crossbill—6 specimens.
Crows—8 specimens.
Dipper—1 specimen.
Duck Hawk—1 specimen.
Eagle, Bald—1 specimen.
English Sparrow, Suppression of—2 specimens.
Flicker—3 specimens.
Grebe—1 specimen.
Grebe, Horned—2 specimens.
Green Heron—2 specimens.
Grosbeak, Cardinal—1 specimen.
Grosbeak, Pine—4 specimens.
Hawk. One specimen killed 19 birds. Protection of Hawks. Specimen in Barn. Young Hawk—1 specimen.
Hawk, Cooper's—1 specimen.
Hawk, Red-shouldered—4 specimens.
Hawk, Red-tailed—1 specimen.
Hawk, Sharp-shinned—5 specimens.
Hermit Thrush—1 specimen.
Hooded Merganser—1 specimen.
Junco or Snow Bird (Slate-Colored Junco)—1 specimen.
Kingfisher—1 specimen.
Lark, Meadow Lark—1 specimen.
Logger-headed Shrike—1 specimen.
Long-eared Owl—1 specimen.
Marsh Hawk—2 specimens.
Maryland Yellow-throat—1 specimen.
Murre—1 specimen.
Night Hawk—1 specfmen.
Nuthatch—1 specimen.
Oriole—1 specimen.
Osprey—1 specimen.
Oven Bird—3 specimens.
Owl, Screech—2 specimens.
Owl, Gray Screech Owl eating a White-winged Crossbill—2 specimens.
Owl, Great-horned; this species devoured a Screech Owl. Protection of—3 specimens.
Pheasants, Breeding Meal Worms for food of—1 specimen.
Owl, Barred—1 specimen.

Pigeon, Wild, inquiries concerning.
Red Bird.
Red-brested Merganser.
Red-winged Blackbird—2 specimens.
Robin feeding upon Cutworms—1 specimen.
Robin charmed by Blacksnake.
Rose-breasted Grosbeak—1 specimen.
Ruby-throated Hummingbird—2 specimens.
Sapsucker, Red-headed.
Scarlet Tanager—2 specimens.
Short-tailed Shrew—2 specimens.
Song Sparrow—5 specimens.
Sparrow Hawk—3 specimens.
Sparrows, Java.
Vesper Sparrow—1 specimen.
Whip-poor-will.
White-breasted Nuthatch—1 specimen.
Woodpecker boring in solid wood.
Woodthrush—1 specimen.
Wren.
Yellow-bellied Flycatcher—1 specimen.
Yellow Warbler.

Our records show that there were several specimens of the American Goshawk or Northern Hen Hawk received last fall, and before that time there were practically none. This shows that there was a southward flight of them from the northern counties which they inhabit and where they breed and spend the summer. This is one of the birds that is not protected by law in Pennsylvania, although it is rare and only a winter migrant.

We have received further reports concerning Blackbirds injuring English Walnuts by puncturing them while they are soft and growing upon the trees. As reported last year, their purpose in making this injury is not known to us.

A great deal of our correspondence has been upon the subject of the English Sparrow, due to a bill introduced in our State Legislature by Hon. William Barnhart, providing for a careful and accurate investigation of the economic features and habits of this bird and the methods of destroying it if found advisable, and the publication of a special bulletin upon this subject, also appropriating one thousand dollars ($1,000) for this purpose. It is thought its failure to pass the Legislature was due to the provision calling for "investigations" of the Sparrow, thus giving him a fair chance to be tried. It is our opinion that had it called for the extermination of the Sparrow, it would have received favorable action by the Legislature, but the important question would then come as to the methods of exterminating the English Sparrow in a way that would prove safe, effective, and not too expensive. Various methods would have to be devised and tested, and we fear that after all is said and done

we must acknowledge the presence of this nuisance of the feathered tribe as a necessary evil that can not be abated.

One correspondent wrote us that he had succeeded in poisoning it and destroying it in his region by the use of poisoned millet seed. He fed the birds on untreated seeds until they become accustomed to them, and after a few days soaked some millet seed in water with a very slight touch of strychnine added, and them dried them and mixed one part of these poisoned seeds with nine parts of unpoisoned seeds. The birds ate this mixture without suspicion and were killed by it. He said he found wheat grains too large to be readily swallowed by the English Sparrow without it having time to taste the bitterness of the strychnine and become suspicious of the material as a food. This is a suggestion worthy of the action of persons desiring to kill the English Sparrow and thus avoid loss by its ravages and driving away our native birds. It should be remembered that poisoned grain of any kind must be placed where it will not be found and eaten by poultry.

The last Legislature also saw the introduction of a bill providing for making the Flicker a Game Bird. This was championed by a representative from one of our eastern counties, but upon the appearance of your Ornithologist before the Honorable Committee on Agriculture, by invitation of said Committee, and his speaking in behalf of the Flicker, showing that it is a beneficial bird and should be preserved, the bill fortunately died in committee.

The Screech Owl fortunately is becoming more abundant in some portions of our State, as popular sentiment is increasing for its protection, and it is permitted to nest and remain in hollow trees and posts and other available places in boroughs. As it increases in number the English Sparrow and mice, upon which it chiefly feeds, decrease perceptibly. We have recently had a very gratifying report from Coatesville, Pa. confirming this statement. The Screech Owl is among the chief enemies of house mice and the English Sparrow, and we hope to see it faithfully protected around buildings and in villages where it should become much more abundant. One of our peculiar records is the finding of a Screech Owl in the stomach of a Great-horned Owl. It is well known that owls are sometimes cannibals.

During last spring we had a very interesting experience with the Robins apparently pulling cabbage near Harrisburg. The account of this was published in our July Bulletin and attracted a great deal of attention. It is as follows:

Robins Destroy Wireworms.

Difference Between Observation and Interpretation.

It frequently happens that certain facts are observed definitely and consequently can not and should not be denied, but the interpretation is such that might lead to quite erroneous conclusions, and even evil results. One of the most important duties of the teacher of Nature Study or any branch of Natural History is to give training not only of the minute observation of facts, conditions and phenomena, but also their own interpretation and practical application.

An important case illustrating the difference between interpretation and observation is seen in that of a truck grower near Harrisburg, who recently observed Robins at work in his cabbage field, apparently pulling the cabbage plants in numbers, and he at once shot quite a number of the birds. When brought to trial by the Game Commissioner, he acknowledged having shot the birds because they were destroying his property in pulling the cabbage plants, and testified that he had seen them take the plants in their bills, pull them up and throw them aside. He was not certain that they ate any part of the plant nor anything near the plant, and it might have been thought that they were doing it only for mischief. Doubting such an unusual occurrence as Robins pulling plants for the purpose of destroying them or without some definite and doubtless beneficial end in view, a representative of the office of the Economic Zoologist went with the Game Commissioner to the truck field where the cabbage was growing, and there they saw, indeed, Robins in considerable numbers hopping over the ground, and often stopping to pick up objects, and even scratching in the ground with their bills, and then eating something. They were particularly busy quite near the cabbage plants, and a number of plants were seen lying on the ground beside the hills, wilted and dying. A careful examination revealed the fact that the plants had been cut off rather than pulled out, and in at least one case the Robin was seen to throw aside one of these plants, which had been cut off but was yet standing in its hole in the ground. Around the foot of the plants and just beneath the surface of the soil worms were to be found by the hundreds. It was found that the wirewroms had cut the cabbage plants, and the Robins were busily engaged destroying these very injurious pests for which there is practically no remedy, after they appear, and of which there are far too few enemies. The facts were that the truck grower observed the Robins at work around his cabbage plants, and perhaps occasionally lifting out some that had been cut off by wireworms, and he jumped to the conclusion that

the Robins were pulling his plants, and proceeded to shoot his most beneficial friends. The correct interpretation was that the plants were cut off by pests for which there is no practical remedy at this time of year, and the Robins were feeding extensively on those pests, but as some of the plants remained in the ground where the wire-worms were to be found, although cut off and dying, the birds found them in their way and threw them aside. It is doubtful if the killing of the birds was justified under such circumstances, even with the positive and conscientious belief that they were doing damage. It was the duty of the truck grower to ascertain the facts of the case and act intelligently upon them, fully as much as it was his duty or privilege to protect his crops.

Details of the above case are published for the sake of emphasizing the importance of correctly interpretating what is to be observed in Nature, and acting most intelligently and properly. It is generally wrong interpretation of observed facts which leads to the common popular errors concerning Natural History subjects rather than mere fabrication of false belief: For example, the popular erroneous idea that there is a Horn Snake with a poisonous sting in its tail appears to be founded upon the observed fact that the House Snake or Milk Snake has a tail that is rather hard and pointed, and from the observation of this, the story of the Horn Snake appears to have grown. It is to be hoped that readers will join in aiding the work of the Economic Zoologist to ascertain and publish the truth in Nature.

There has been a great deal of complaint concerning foreigners shooting birds. It appears that in the Old Country even the smallest birds are shot and trapped for food, and foreigners do not learn to respect our laws in this regard. The Game Commissioner has had a great deal of trouble in attempting to enforce the laws for protecting birds among foreigners, especially in the mining region. His efforts are commendable and good results are seen.

We have received inquiries concerning spray liquids killing birds, and have replied to the effect that we believe this never results. The only way in which the poison could be taken or such results could occur would be by the birds eating insects that have been poisoned by feeding upon foliage holding arsenical insecticides or eating poisoned fruits. As birds do not eat dead insects this can not occur as one of the undesirable results of spraying.

Something has been said concerning the introduction of Pheasants in this country. This is commendable and could no doubt be made successful. The Pheasant in its habits can be considered as intermediate between the Ruffed Grouse or our common game bird commonly but wrongly called the "Pheasant" and the domesticated Guinea.

It would thrive along the edge of thickets and in partially open pastures, in practically the same places as the Quail preferred when it was abundant in this State. It is a beautiful bird, insectivorous and seed-eating in its feeding habits, and might become one of our important game birds. It has been successfully introduced along the western coast of the United States, and we know of its breeding undomesticated in the State of New York. We would recommend it as a bird to propagate and introduce in this State.

The reduction of the number of Quail by severe weather during the past two years has been quite perceptible. The Quail is one of our most valuable insectivorous birds, being destructive to potato beetles, grass-hoppers and other obnoxious insects. It is also an important destroyer of weed seeds. For this reason we earnestly recommend the endorsement of legislation proposed by our State Grange at its last Annual Meeting, calling for a closed season of five years for the Quail or Bob White.

Concerning the Game Laws of the State of Pennsylvania we should offer a paragraph:

The law at present provides bounties upon certain animals as follows: For each wildcat, four dollars; for each fox, two dollars; for each weasel and mink, one dollar.

We agree with the publications of the Biological Bureau of the U. S. Department of Agriculture, to the effect that bounties are not justifiable, cost too much, and do not bring the desired results. If creatures are sufficiently obnoxious to demand the efforts of mankind in exterminating them this will be done, bounty or no bounty.

All species of birds are protected by law in this State at all times excepting the Bluejay, English Sparrow, European Starling, the Kingfisher, Cooper's Hawk, Sharp-shinned Hawk, Goshawk, Duck Hawk, Pigeon Hawk, Great-horned Owl, Barred Owl, the Crow and the Raven, and the game birds which are to be shot only during their respective open seasons, and which are named by our State law as the Quail, Ruffed Grouse, Prairie Chicken, Imported Pheasant, Wild Turkey, Wild Pigeon, Dove, Reed Bird, Rail, Blackbird, Sandpiper, Tatler, Curlew or any Shorebird, Wilson Snipe (Jack Snipe), Upland or Grass Plover, Coot or Mud Hen, and Water Fowl known as Duck, Goose, Brant, Swan and Grebe. We can not see the justification in having the Dove, Blackbird, Coot or Mud Hen and Grebe upon the list of game birds, as the first-named is the only one that is edible, and the others would be shot only for useless "sport." The law provides, fortunately, for an absolutely closed period upon the Wild Pigeon until April 22, 1915. However, it is our opinion that at that date it will be found, unfortunately, that there will be none of these very interesting birds in our State.

The Audobon Society is growing stronger both in Pennsylvania and in the United States and is doing good work in bird protection and in creating and maintaining public sentiment in this regard. In the Report for Pennsylvania by the State Secretary, Miss E. W. Fisher, which was published in "Bird Lore," Volume IX, No. 6, for November and December, 1907, is the following:

" * * * The business of reorganizing the Society on this permanent basis represented most of the 'new work' done this spring, but the old activities were still kept up. Twelve circulating libraries were kept moving in the State, and a number of school children and children in societies, such as 'Bands of Mercy,' etc., have signed the Audobon Pledge and received certificates of associate membership.

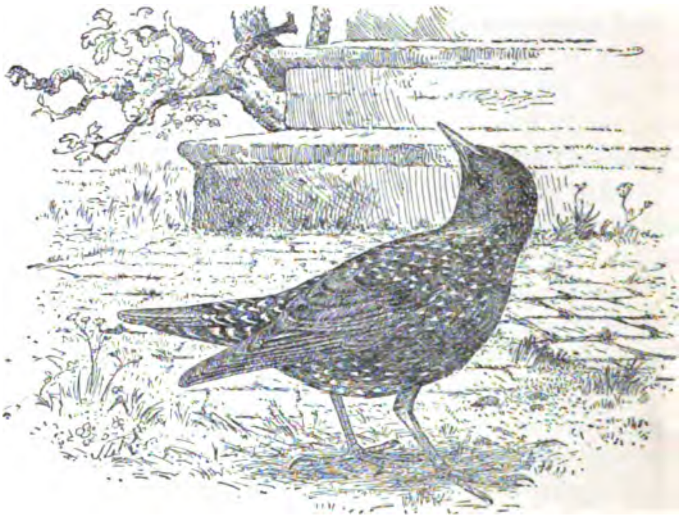
"The increase of the public sentiment for bird protection has been quite marked during the past year in this State, largely due to the good work done by the State Zoologist, and the Audobon literature distribution in schools. Indeed, it is to the intelligent work of the public school teachers who take up the subject that the Audobon Society owes some of its best results in the country districts.

"The society hopes to follow up its organization this winter with several public meetings, where illustrated talks will be given by those prominent in bird protection and ornithology (which seems still to be one of the most successful ways of reaching the general public), and by special work among the schools."

Considerable literature has come to our desk. One of the most commendable was Bulletin No. 30, by the Biological Survey, of the U. S. Department of Agriculture, entitled "Birds of California in Relation to the Fruit Industry." This consists of one hundred pages with five plates and will prove of considerable interest to bird students. We regret to be obliged to chronicle the suspension of a valued and interesting publication known as "Birds and All Nature," by the Nature Publishing Company, of Chicago, as this pictured objects in natural colors, and was commendable in its popular instruction. The Ornithologist of your Board has prepared a set of colored slides of birds and occasionally gives popular lectures on this subject, the last having been as recent as last Friday night to a church audience in Harrisburg. We recommend further activities in bird protection and intelligent legislation along this line.

Several reports have reached us concerning the increase of the English Starling and the damage done by this bird, which appears to be in its habits and haunts or place of living intermediate between the Blackbird and the English Sparrow. We regret its introduction into this country, and recommend its destruction. It appears to be a grain eater and fruit eater without much value as an insect-killer. We here show specimens of the same, with the hope

that it will be more readiliy recognized than from descriptions. These specimens were kindly loaned for this purpose by Dr. William Deutcher, of the American Museum of Natural History, who is president of the American Association of Audobon Societies. The Starling resembles a brownish blackbird with white specks or small spots on the back, but its long-drawn whistling note enables it at once to be distinguished from any blackbird found in this State.



English Starling (Sturnus vulgaris).
From Palmer, Year Book U. S. Dept. Agri., 1898.

(B l x m s h)

THE

ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

VOL. V, No. 11.

SUBJECTS: Spraying,
Report of Entomologist.

March 2, 1908.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR MARCH, 1908.

VOLUME V, NO. 11.

Established in April, 1903, at the office of the Economic Zoologist.
Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

CONTENTS OF THE MARCH BULLETIN.

OUR MONTHLY CHAT WITH READERS.

Possible Change of Bulletin: In order to avoid a misunderstanding and perhaps considerable explanatory correspondence we take this occasion to announce that there is a possibility of changing the Bulletin of the Division of Zoology from a Monthly to a Quarterly issue, beginning in May. This may become necessary on account of the unusual demand for field work and out-door service made upon the Zoologist in connection with the demonstration orchards which we are establishing. If this change is to be made a definite announcement will be given in the April Bulletin.

The Demonstration Orchards: We again call the attention of the public to our plans to establish demonstration orchards in many of the fruit-growing counties of Pennsylvania, to continue them throughout the year and show how to produce good fruit by controlling insects and preventing plant diseases, and to demonstrate methods of good orcharding in general. The locations of these orchards are announced in other portions of this Bulletin, and everybody interested is invited to see them. Announcements will be made by the local papers concerning the exact dates when we shall be present at the demonstration orchards.

Changing Addresses: In writing us for change of address the old as well as the new address should be given in order that we can find the names according to the system by which we have them arranged.

Writing Names Plainly: There is nothing with which a correspondent is so familiar as his own name, and nothing which he writes so frequently, so easily, and consequently so carelessly. At the same time there is nothing so important in a letter as the signature and address of the writer. Proper names are difficult to recognize, and the greatest possible care should be used to write them so plainly that there will be no mistake concerning either the address or the name of the writer. The chief cause of failure of replies to reach their proper destination is to be found in the inability to determine these accurately when written by hand.

Do You Receive Our Bulletins? We aim to publish in the Bulletins during sometime of the year something concerning practically every important plant pest in this State. It frequently happens that inquiries are made upon topics previously discussed at length in some number of Bulletins. It would save us considerable

time and correspondence if we knew the inquirer had Bulletins at hand and we could give reference by number of page, citing the exact information wanted. If the inquirer has not received Bulletins we can in most cases send a copy of the issue discussing the subject in question. It is not economical to pay postage and send duplicate Bulletins to persons who already have them. It would save for us several days per month if we knew that inquirers were receiving and preserving the Bulletins, for in attempting to answer letters in detail we could refer to pages where the desired information is given.

All communications and specimens should be addressed to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

RESULTS OF SPRAYING EXPERIMENTS DURING THE SPRING OF 1907 FOR SAN JOSE SCALE.

Experiments for the control of the San José Scale were performed during the winter and early spring, before the leaves had started. Most of the experiments were performed on trees on the farm of Prof. Surface, as he gave us the privilege to test any material that we considered worth the time and expense of trying as an insecticide to control the Scale. The first requirement was to learn the proper strength to use, so there was a necessity of using the solutions very strong in some instances. This resulted, as might be expected, in the destruction of twigs or branches in some instances, and at other times it resulted in the destruction of fruit buds. It is only by such trials that we can ascertain the "danger point" of any insecticide or fungicide so that it was a great privilege that we could use a private property as an experimental farm. These facts, which are of such practical value to the farmers and fruit growers of this State, could not have been learned except by making the actual tests, regardless of the effects on the trees.

1. The Lime-Sulphur Wash: This wash was made according to the regular formula: 17 lbs. of Sulphur, 22 lbs. of Lime, and 50 gallons of water. These materials were boiled together for one hour, and applied hot, using either a York Gas Sprayer or a Niagara Gas Sprayer, at a pressure of 60 to 100 pounds to the square inch, except in a few instances which will be mentioned in due order. In fact all the experimental spraying mentioned in this report was performed with the apparatus mentioned above.

On December 5, 1906, twenty peach trees were sprayed. March 5, 1907, forty trees were treated in a similar manner. On April 16, four more trees (peach) were sprayed. These trees were in the same orchard, which we designate as orchard No. 1, and they were badly infested with San José Scale. The trees were also in a poor condition, due to lack of cultivation and trimming, and they were also badly infested with Borers. This does not mean that the present owner has neglected them, but that they were in that condition when the farm was bought this year. The trees had been neglected for several years, and due regard must be given this fact in judging of results. A second application of the Lime Sulphur Wash was given to nine trees of the group that were sprayed December 5th. This was applied on April 16th.

On this farm is another orchard of peach and apple trees, all about five years of age. They are in a healthier condition than the trees in the first orchard, as they had received more cultivation, but they were rather badly infested with Borers. This orchard is known as orchard No. 2.

Seven peach trees badly infested with Scale, 6 peach trees that were free from the pest, and 7 apple trees that were moderately infested, were sprayed on April 9. The leaf buds had burst and the leaves were ½ inch in length.

Results.—These trees were examined from time to time and the effects of the Lime-Sulphur Wash on the foliage and on the Scale were carefully noted. There appeared to be no injury to the fruit or leaf buds on any of the trees that were sprayed before the buds had begun to burst, but on those trees where the foliage had appeared at the time of spraying, it was burned rather badly yet the fruit buds were not hurt in the least.

The percentage of Scale killed did not differ perceptibly on the trees sprayed in December from those sprayed in the Spring. The percentage of Scale killed averaged 96 on peach and 94 on apple for trees sprayed only once, and 98 for peach and 96 on apple on trees sprayed twice. All the trees (peach) were free from Peach Leaf Curl, during the following summer. Peach Rot does not seem to be checked by it. This was a poor season to see the results of the different mixtures on Peach Rot as there was so much dry weather that very little Rot appeared except on trees in lower land.

2. Lime-Sulphur-Salt Wash: This material was made according to the regular formula: 17 lbs. Sulphur, 22 lbs. of Lime, 10 lbs. of Salt, and 50 gallons of water. The wash was boiled for one hour and applied the same as the Lime-Sulphur Wash.

We sprayed 18 trees on March 4, using the wash hot, and 18 trees using it cold. Of these trees, 4 that were sprayed with the

wash hot and two that were treated with the wash cold were given a second spraying on April 16th. These trees were in orchard No. 1. In orchard No. 2, eight trees that were slightly infested and six that were free from Scale were treated with this material, using it hot. These peach trees were treated on April 9th, and the leaves had already started. On the same day, we sprayed 6 apple trees that were slightly infested, 2 that were badly infested, and 9 that were free from Scale. The leaves had started on these trees and were about ½ inch long.

Results.—No injury to the trees were shown in any instance, but the foliage was injured on those trees that were sprayed after the leaves had started. Yet these trees produced a fine crop of fruit, from which fact we infer that it is better to give a tree a late spraying with such material than to allow it to go unsprayed; the best time for spraying being, of course, before the buds have burst. Leaf Curl did not appear on these trees during the summer. As these were late varieties that do not seem inclined to rot, the fact that they did not show any rot does not prove the case, but we do know from previous experiments that this material is a good fungicide and that it will prevent Rot. The percentage of Scale killed averaged 95 on trees treated once, and 96 on trees treated twice. These results were the same on both apple and peach. The results were very favorable to the growth of the trees, as they all made a fine growth and produced a large crop of peaches.

3. Sulphur-Sal-Soda-Wash: This wash was originated by us this Summer. It is made by boiling together 17 lbs. of Sulphur, 34 lbs. of Sal-Soda and 50 gallons of water. Although more expensive than the Lime-Sulphur Wash, it has the advantage of having no sediment, and of covering more trees, gallon for gallon, than any of the Sulphur washes.

On April 10th, 34 trees that were slightly infested, 16 trees that were badly infested, and 30 trees that were not infested with Scale were treated. These peach trees had the foliage about ½ inch in length.

At the same time, 3 apple trees that were slightly infested and 14 that were free from Scale were treated with this wash. All these trees were in orchard No. 2 and were in fair condition.

Results.—None of the trees were injured by this wash, but the foliage was injured, due of course to the late application of the wash. Leaf Curl did not appear on these trees. On careful examination this wash showed 98 per cent. of San José Scale killed on both peach and apple. These trees bore a good crop of fruit, free from rot.

4. Sulphur-Baking-Soda-Wash: This is also an original wash with us, and was made by boiling together 17 lbs. of Sulphur, 20 lbs. of baking soda and 50 gallons of water. It has a tendency to boil over quicker than the other Sulphur washes, which makes it rather troublesome but it produces a wash that has no sediment, and consequently does not demand strainings and does not clog the nozzles if kept clean.

On April 1st, 8 trees that were slightly infested, 5 trees that were badly infested, and 22 trees that were not infested were sprayed with this material. All were peach trees in excellent condition and the foliage had grown ½-inch in length.

Results.—Spraying the trees with this wash did not harm the foliage in the least nor did it harm any of the fruit buds, and it did kill 99 per cent. of the Scale. The trees did not show any Leaf Curl during the summer. These results show it to be a very useful wash where trees are to be treated for Scale after the leaves have appeared. The cost of materials is greater than for the other Sulphur washes though its cost is not prohibitive by any means.

5. Caustic Soda Washes: A number of washes were made by boiling Caustic Soda and Sulphur together in different proportions. Three mixtures were tried.

On March 5th, 16 trees that were moderately infested with Scale in orchard No. 1 were sprayed with a wash made by boiling together for one-half hour 4 lbs. of Caustic Soda, 17 lbs. of Sulphur, and 50 gallons of water.

This wash did not harm any of the trees nor foliage nor fruit buds, but the effect on the Scale was not such as would justify its use, as it did not kill over 80 per cent. of them.

At the same time, 19 peach trees were sprayed with a wash made by boiling 10 lbs. of Caustic Soda, 17 lbs. of Sulphur, and 50 gallons of water. This was boiled one-half hour. This wash did not give results that were entirely satisfactory, as there were some trees that had a large percentage of live Scale left on them. However none of the trees were injured in any way. The failure of this and the preceding wash is due, we think, to the inability of the small amount of caustic soda to combine with the large amount of Sulphur, in this manner making only a small amount of sodium sulphide.

On March 7th, 24 peach trees were sprayed with a wash made by boiling together 20 lbs. of Caustic Soda, 17 lbs. of Sulphur, and 50 gallons of water. This was applied hot, as were the other washes.

This wash killed all the Scale but also killed the fruit buds, although the buds had not begun to swell.

On April 9th, 21 peach trees and 12 apple trees were sprayed with the same wash. The foliage had begun to appear, and that was destroyed the same as with the other Sulphur washes; also the fruit buds were destroyed. We need not add that the Scale were annihilated.

Thus the caustic soda washes did not prove satisfactory in our experiments this Spring, though further experimenting with them may perhaps develop a wash that will not injure the tree yet will kill all the Scale insects.

DEHORNING, OR TOPPING PEACH TREES.

It may be well to mention the results of dehorning trees that have been very badly injured by Scale. When a tree is injured in that way it is necessary to do more than destroy the insects on the tree. It is necessary to cut the tree back so that what strength it may have be directed to as few limbs as possible. It will then send forth new branches and will in the majority of cases live.

Our experiments were conducted on a few peach trees that were very badly injured by Scale. Most of the trees lived. In fact all lived that had a moderate amount of vitality, and our belief is that it is better to cut a tree back rather than to have it be larger and sickly. In every instance of a dehorned tree that grew we found a tree that became very vigorous. Some of the trees that were badly injured by spraying them with caustic soda, were dehorned and they developed into vigorous trees and made a fine growth this Summer.

OUR DEMONSTRATION ORCHARDS.

As previously announced, we have arranged to establish at once a number of demonstration orchards in Pennsylvania for the purpose of illustrating the methods of properly conducting an orchard, with special reference to the control of insect pests and the prevention of plant diseases, and also incidentally showing how to plant, prune, fertilize and cultivate trees, as well as how to spray and perform such other operations as are necessary in practical orcharding. The public is invited to visit these orchards at any time and especially to come at the dates when it is announced the demonstrators will be present. These persons are to be present, regardless of weather. Announcements

will be made primarily through the local newspapers, and also through our Monthly Bulletins.* The demonstrations will be in charge of the respective local demonstrators for each district, but the Economic Zoologist, or one of his Special Assistants will be present at each of the public meetings. At these meetings not only practical work will be shown but addresses will be given, and there will be evening sessions, at many of which illustrated lectures will ge given. Persons desiring to receive aid in orcharding, and especially in the control of pests, are urged to attend, bring samples of twigs supposed to be infested, ask questions, and receive such help as can be given.

For many reasons it has been found best to select orchards in connection with public institutions. The locations of the demonstration orchards for this year, arranged according to Counties, are as follows:

County.	Orchard Of.	Post Office.	Local Inspector.	First Date.
Allegheny,	Beechmont Fruit Co.,	Oakdale,	G. W. Sloop,	Mar. 23 & 24.
Bedford,	County Home,	Bedford,	R. F. Lee,	Mar. 30 & 31.
Berks,	County Home,	Shillington,	E. C. Bowers,	Mar. 16 & 17.
Bucks,	National Farm School,	Farm School,	E. L. Loux,	Mar. 11.
Butler,	County Home,	Butler,	F. L. McClure,	Mar. 18 & 19.
Cambria,	County Home,	Ebensburg,	R. F. Lee,	Apr. 1 & 2.
Chester,	County Home,	Embreeville,	F. Windle,	Mar. 4 & 5.
Clearfield,	County Home,	Clearfield,	R. F. Lee,	Mar. 16 & 17.
Columbia,	Bloom Poor District,	Bloomsburg,	A. W. Stephens,	Mar. 6 & 7.
Cumberland,	Indian School,	Carlisle,	F. Z. Hartzell,	Mar. 20 & 21.
Dauphin,	County Home,	Harrisburg,		
Delaware,	County Home,	Lima,	M. E. Shay,	Mar. 6 & 7.
Huntingdon,	Industrial Reform School,	Huntingdon,	J. Bergy,	Mar. 26 & 27.
Indiana,	Frank H. Dougherty,	Indiana,	G. W. Sloop,	Mar. 27 & 28.
Lackawanna,	Randolph Crippen Est.,	Dalton,	A. O. Finn,	Mar. 9 & 10.
Lancaster,	Home for Friendless Children.	Lancaster,	J. D. Herr,	Mar. 2.
Lancaster,	County Home,	Lancaster,	J. D. Herr,	Mar. 3.
Lebanon,	County Home,	Lebanon,	F. R. Fertig,	Mar. 18 & 19.
Lycoming,	City Home,	Williamsport,	T. C. Foster,	Mar. 11 & 12.
Mifflin,	County Home,	Lewistown,	J. Bergy,	Mar. 24 & 25.
Montgomery,	Insane Hospital,	Norristown,	J. S. Briggs,	Mar. 9 & 10.
Montour,	Insane Hospital,	Danville,	A. W. Stephens,	Mar. 4 & 5.
Northampton,	Carter Junior Republic,	Redington,	P. R. Boltz,	Mar. 12 & 13.
Northumberland	Odd Fellows Orphanage,	Sunbury,	A. W. Stephens,	Mar. 2 & 3.
Perry,	County Home,	Loysville,	T. C. Foster,	Mar. 23 & 24.
Tioga,	Geo. T. Hatherill,	Wellsboro R. 1,	M. L. Benn,	Mar. 13 & 14.
Union,	J. N. Glover,	Vicksburg,	T. C. Foster,	
Venango,	Inst. for Feeble Minded,	Polk,	F. L. McClure,	Mar. 20 & 21.
Westmoreland,	County Home,	Greensburg,	G. W. Sloop,	Mar. 25 & 26.

For the pruning and preliminary demonstration work there will be two sections operating simultaneously. The first of these in general charge of Mr. W. E. Grove, of York Springs, is arranged as follows according to the series of dates assigned:

Mar. 2 and 3, Home for Friendless Children, Lancaster.

Mar. 4 and 5, County Home, Embreeville, Chester county.

Mar. 6 and 7, Delaware County Home, Lima.

Mar. 9 and 10, Insane Hospital, Norristown, Montgomery county.

Mar. 11, National Farm School, Farm School, Bucks county.

*It is unfortunate that the Bulletins are delayed waiting for plates to be made until it is necessary either to omit plates or issue the Bulletins late. We hope soon to find means of correcting this.

Mar. 12 and 13, Carter Junior Republic, Reddington, Northampton county.

Mar. 16 and 17, Berks County Home, Shillington.

Mar. 18 and 19, Lebanon County Home, Lebanon.

Mar. 20 and 21, Indian School, Carlisle, Cumberland county.

Mar. 23 and 24, Perry County Home, Loysville.

Mar. 24 and 25, Mifflin County Home, Lewistown.

Mar. 26 and 27, Industrial Reform School, Huntingdon.

Mar. 30 and 31, Bedford County Home, Bedford.

April 1 and 2, Cambria County Home, Ebensburg.

The second section will be in general charge of Mr. A. W. Stephens, and is arranged according to dates as follows:

Mar. 2 and 3, Orphanage, Sunbury, Northumberland county.

Mar. 4 and 5, Insane Hospital, Danville, Montour county.

Mar. 6 and 7, Bloom Poor District Home, Bloomsburg, Columbia county.

Mar. 9 and 10, Randolph Crippen Estate, Dalton, Lackawanna county.

Mar. 11 and 12, City Home Farm, Williamsport, Lycoming county.

Mar. 13 and 14, G. T. Hatherill's orchard, R. D. No. 1, Wellsboro, Tioga county.

Mar. 16 and 17, Clearfield County Home, Clearfield.

Mar. 18 and 19, Butler County Home, Butler.

Mar. 20 and 21, Institute for Feeble Minded, Polk, Venango county.

Mar. 23 and 24, Beechmont Fruit Co. Orchard, Oakdale, Allegheny Co.

Mar. 25 and 26, Westmoreland County Home, Greensburg.

Mar. 27 and 28, F. H. Daugherty's orchard, Indiana.

Some counties are not announced at this time because arrangements are not yet completed for establishing demonstration orchards in them, and others can not be undertaken this year on account of insufficiency of funds to make the work more general. Special efforts will be made next year to give particular attention to the counties that can not be reached this year.

While all the work in these orchards will be public, the afternoon and evening of the first day at each place mentioned above will especially be devoted to metings for the purpose of discussing subjects in orcharding. These meetings will be held in the orchard and in a meeting room most available and convenient for the purpose. Readers are requested to aid this work by notifying and inviting their neighbors, and by seing that all the local papers

receive notices of the coming meetings. Those meetings that are to be held before this Bulletin is mailed will be announced in time through the county papers by notices sent directly from this office.

ERRORS IN SPRAYING.

Notes from an Extemporaneous Address by H. A. Surface, Delivered at the Recent Annual Convention of the Ontario Fruit Growers' Association.

A number of erroneous impressions are common in regard to spraying. There is a general impression that spraying is a preventive of all loss in fruit growing. Nothing can be more fallacious; it is not. There are many horticultural ills that spraying can not remedy. First, there is a general feeling that it is necessary to spray to prevent the appearance of insects. I know of only one insect for which we spray to prevent its coming: That is the larva of the codling moth. We do not spray to prevent the coming of insects, although we do spray when they are present to destroy them and prevent loss by their attacks. If I had an orchard free from insects, I should not spray with anything, so far as insects are concerned, until the pests appear, excepting that I would spray at the proper time and with the proper material for the codling moth.

There is a very general impression that Bordeaux mixture is an insecticide; it is not. At the same time, it may act as a repellant and drive away certain insects. It is simply a fungicide, composed of copper sulphate and lime, and if we wish to make an insecticide of it, we must add an arsenical poison.

There is also an impression that Bordeaux mixture will cure plant diseases. There is a difference between curing and preventing. Prevention is better than remedy. It will not cure fungus diseases, but will help prevent their appearance. There is a great difference between spraying with insecticides and with fungicides; the difference is this: With insecticides, in all cases save that of the codling moth, we spray, when the pests are present, as a remedy; with fungicides, we spray to prevent the appearance of a disease, such as scab, leaf spot, rot, mildew, peach leaf curl, etc. After such a disease as leaf spot or fungus has started in a leaf it can not be cured in that leaf, or after the rot disease appears in a fruit it can not be cured in that particular fruit.

Again, there is an impression in our State that benefits can come from spraying trees in bloom. We should not spray blossoms, and no benefit of any kind is to be had from doing so. It is bad horticultural practice. If there be a surplus of blossoms and you wish to reduce them it will help to thin the crop, but it is a poor way of thinning, and not to be recommended. I have seen abortive fruit produced in this way, and besides, there is the danger of killing bees, which do so much to fertilize and cross fertilize the blossoms.

There used to be an idea that spraying would poison fruit and vegetables. This especially was thought to be the case in spraying cabbage for the cabbage worm. Our best gardners spray cabbage with Paris Green, and analyses show that a person would have to eat about two hundred cabbage heads to get enough Paris Green to affect him. Spraying does not poison fruit and there is no danger of its doing so.

Another mistake is the thought that animals are liable to be poisoned by eating the grass under trees sprayed with Paris Green or Arsenate of Lead. There is almost no danger in this respect. Of course there should be no grass in the orchard, unless the "sod-mulch" system is being practiced—a method that is well worth trying.

There is an idea that spraying kills bees. With lime-sulphur wash that is absolutely wrong as the wash is applied before the buds burst. With other insecticides there is no danger as long as they are not applied while the blossoms are open.

A writer for "Cyclopedia of Agriculture," recently wrote an otherwise excellent article on birds in relation to Agriculture, in which he made the remarkable statement that birds are liable to be killed by modern methods of spraying. I consider this an error. Spraying does not kill birds, and I wrote the Editor saying that if the statement were published, I should protest it and that others would protest it too. I am glad to learn that it was stricken out of the proof.

Many people think that if a little is good; more is better. That is a very poor belief. There is more danger from too much than there is from too little. Too much many endanger or kill the plant. Too diluted a formulae may result in not accomplishing the work for which you are spraying—in not preventing the disease or killing the insect—but you will have no other loss than that of time and material and possibly the effects of continued pests; whereas, if you use too much you are liable to injure the fruit or even kill the trees. There are certain materials of which it makes little difference if you use too much, such as the lime-sulphur mixture and the Bordeaux mixture, applied when not in leaf.

The question has been raised as to whether aphids could be killed by the lime-sulphur wash. I know it can be done, as I have seen the boiled lime-sulphur wash clean up both the Apple aphis and the Cherry aphis, applied just before and when the buds were bursting.

It is the general opinion of too many spray pump operators that materials can be mixed by guess. They should be weighed and measured most carefully, to the very ounce. When I tell a man to spray eight per cent. kerosene I do not mean ten per cent., and if he should use four per cent. or five per cent. above what I say he is to use, it is liable to result in injury to his trees, under certain conditions. A man should know the exact percentage to use, as well as the correct time to apply it.

There is a general impression that spraying can be done when the wind is blowing and satisfactory results obtained. It is almost impossible to spray against the wind. You should spray with the wind, and cover that side of the tree; then you must wait till the wind has ceased or changed direction before spraying the other side. That is the only proper way to spray if windy. You can not throw a spray against the wind, although you might use a squirt-gun or a fire-hose and throw a stream or jet, but that is not spraying. The spraying material, in a fine state of division, should drift over the trees in the form of a mist, and not be thrown as a stream, and sometimes (when trees are in leaf) not under too great pressure. I have known of cases where so much pressure was used with Bordeaux mixture that the material was actually driven into the stomata or pores of the leaves, which were severely injured in consequence. There is a possibility of injury by using too much power when the leaves are in a delicate or tender condition.

Question—Would 35 pounds pressure be about right?

Answer—Yes, and then you will not have this difficulty. Many people using power outfits spray at 60 to 80 or more pounds pressure, and rarely get below 40 pounds. High pressure will not cause injury when trees are dormant.

Many suppose that the height to which the spray is thrown depends solely upon the power of the apparatus. That is not so. What is required more than anything else for spraying very high trees. is a sufficient length of hose and an extension rod, with ladders for operators to climb.

Efficient spraying cannot be done with poor, cheap, hand apparatus. For the average orchard I would not recommend anything cheaper than a good barrel sprayer, with at least twenty-five feet of hose and an eight-foot extension rod.

Many men seem to think that one spraying should be enough. Some write me, "I sprayed my trees once and the scale is still there; I am disgusted with the formula you recommend." It takes more than one dose of medicine to cure a disease, and more than one spraying to overcome scale.

If we can control the San José Scale, and produce first-class fruits without much expense, that ought to be sufficient to satisfy us for the present, we can never get rid of it entirely, but may eradicate it from some individual orchards. Do not think you can spray two or three infested trees in an orchard and leave the rest. Under such conditions all the trees should be sprayed, being sure of the second or re-touching spraying.

Some think they can modify the formula recommended and get better results. It is not safe to attempt it.

The following facts are not generally known:

That sprayed fruit keeps longer than unsprayed, without storage or special treatment.

That sprayed fruit stays on the trees much longer than when unsprayed.

That some diseases are not to be prevented by spraying, namely, apple and pear blight and peach yellows.

That pruning invigorates a tree and is one of the essential steps in combatting its pests.

The operation should be for a definite object; we should know for what we are spraying, then spray thoroughly with the right material in the right proportions, with the proper apparatus, at the right time. This is a very important thing. Spraying is not in itself sufficient to produce good fruit; we must have cultivation, pruning and thinning of fruit, and finally we must spray as the most satisfactory means of controlling insect pests and preventing plant diseases.

Question—Do we understand you to say that spraying will not prevent leaf curl?

Answer—It will prevent, but not cure it after it has started; after the leaf has started to curl, it will not cure it. There is a difference between prevention and cure.

Question—How soon after the leaves are off is it safe to spray for Scale in the fall?

Answer—At least ten days should elapse after the leaves are off. The base of the petiole of the leaf leaves a deep surface scar, and until this heals over it is not advisable to spray. (This refers to fall spraying for scale insects.)

In spraying for codling moth, the important point is to spray just after the petals fall, and then again after (10) ten days time.

Some of our growers are getting 98 per cent. perfect fruit. You may use Paris Green and Bordeaux mixture together, although I believe Arsenate of Lead is more effective and nearly as cheap as Paris Green, but a good unadulterated Paris Green is excellent. Use a third of a pound of Paris Green or two pounds of Arsenate of Lead in fifty gallons of the Bordeaux mixture.

Question—What do you use for Oyster Shell Bark louse?

Answer—I have seen bad infestations entirely cleaned up by one double spraying of lime-sulphur wash, in the fall of the year. This mixture will kill all the scales, and also the cigar case bearer. eggs of the tent caterpillar, Aphids, and many other insects.

Question—What do you mean by double spraying?

Answer—Two coats: the second applied just after the first coat is dry; for Scale always give the trees this re-touching spray. This is especially necessary in spraying for San José Scale.

Our best growers are spraying once every year (in the early Spring), because the Lime-Sulphur wash has such a tonic effect on the trees, although it may not be absolutely necessary in order to keep the scale in check.

Question—Do you recommend scraping?

Answer—I do not think it necessary as far as scale is concerned

Question—Does it injure the tree?

Answer—It can, if too deep. You should not scrape so deeply as to injure the inner bark.

Question—Is salt of any value in the mixture?

Answer—It is not necessary, and we do not now recommend it. When salt is added to this mixture there sometimes may be injury to peach twigs and buds by spraying just after the leaves fall.

We are in the midst of experiments with Sulphur-Soda Wash, as a treatment for San José Scale. Our first experiment killed the fruit buds, and we have not experimented far enough for me to say at just what strength it should be used with safety. My opinion is that it should be about as follows:

Four lbs. caustic soda or concentrated lye, or even washing soda, boiled with three times as much sulphur, for half-and-hour, and diluted with forty or fifty gallons of water. Those who try it it should do so only experimentally and on a small scale.

SPRAYING BREVITIES.

1. The best time for spraying for San José Scale, green lice or aphids, peach leaf curl and some other pests is in the early

spring just as the buds are swelling and just before the leaves appear, although good results can be obtained by spraying with proper material at any time when the tree is dormant. The best material for use in the control of the San José Scale is the Lime-sulphur wash boiled one hour, either made at home or purchased ready made of some such firm as the Niagara Spray Company, of Middleport, N. Y. The commercial is as efficient as the home-made material and cheaper than any other commercial insecticide, and has the advantage of also being a fungicide. The homemade Lime-sulphur wash is made by boiling sulphur, seventeen pounds, with Calcium Lime, twenty-two pounds in anything but copper, for one hour, with enough water to keep it boiling, and afterward dilute with water to make fifty gallons. Sulphur can be purchased from such firms as the following:

The General Chemical Co., 608 Bourse Building, Philadelphia.

Powers-Weightman-Rosengarten Co., Philadelphia.

The Thomsen Chemical Co., Baltimore, Md.

2. The chief preparation for spraying should be a careful pruning of the orchard and equipment with ladders, hose and a metal strainer. The operator should be protected by the use of cheap leather gloves dropped into melted tallow, and vaseline rubbed on the exposed parts of the skin. It is advisable to wear goggles or protecting glasses over the eyes and also protecting cloth around the neck.

3. Apparatus. The apparatus must be adapted to the number and size of the trees. In general a barrel outfit, with an air chamber that will give a strong even pressure and work smoothly and easily will serve the purpose in all but a most extensive orchard. Use at least twenty-five feet of good strong hose, an extension rod and eighth-turn and a cluster of two or three nozzles on the eighth-turn.

4. Always use Calcium Lime. This does not become dark green when boiled but remains the color of cooked tomatoes. It is stronger than the Magnesium or milder Lime.

5. To keep Lime fresh buy as much as may be wanted and keep it in vessels under water in the form of paste. Use three times as much of the Lime as the dry in any formula.

6. Use long hose. The successful spraying of tall trees does not depend so much on the use of powerful apparatus as upon hose, extension rods and ladders to get the nozzles to the tops of the trees.

7. Always use an extension rod. This may be from six to eight feet long. It can be made of ordinary gas pipe, with the joint and connection at the middle to take it apart for carrying if desired.

8. Have a "Y" attachment on the extension rod provided for carrying either two or three nozzles. Of the oldstyle "Vermorel" nozzle at least three should be used, but of the "Mistry" nozzle two at a time are sufficient.

9. By all means use on the end of the extension rod a small bent attachment called "eighth-turn." Turn the nozzles slightly to one side, or use a metal extension rod with the farther end bent slightly to one side.

10. For economy the extension rod can be made of ordinary gas pipe and if desired jointed at the middle, so it can be taken apart for convenience in carrying.

11. Always give the second or retouching spraying at any time after the first coating becomes dry enough to permit the operator to see what spots have been missed.

12. When the wind is blowing spray from one side or with the wind only, giving both the first and second coats from this side if desired, and when it changes or ceases, spray the other side thoroughly.

13. To spray high trees is not so much a question of pump power, as of sufficient hose, extension rod and ladders or elevation to get the nozzles to the tops of the trees.

14. Be sure all bark is well covered from the tips of the highest branches to the base of the tree.

15. Before spraying prune out all wood that is dead or dying and all that is superfluous and makes the top one-sided or too bushy.

16. After spraying prune off all twigs and branches that could not be reached and well covered.

17. Protect the hands and faces by proper covering, and the horses by the use of blankets.

18. Always strain all substances containing Lime or other sediment by pouring it through a conical strainer, such as was described and illustrated in our October Bulletin, or through wire cloth having about twenty-eight or thirty meshes to the inch.

19. Commercial Insecticides are not as economical as the home-made, and often not as effective nor as safe, but the commercial Lime-sulphur Liquid can be found as reliable as the home-boiled material.

20. Be careful about using oils, either home-made or commercial, as when used strong enough to kill the scale they are liable to injure the trees as we have personally observed and as have many recent reports indicated.

21. If an oil spray should be used shim off all oil that does not dissolve in the water in the spray tank.

22. Do not experiment extensively and do not use much new material at one time. Try it first on a few trees.

23. The San José Scale is not "dying out," except by the faithful and intelligent use of the spray pump or by killing the trees that it infests.

24. Painting will not take the place of spraying, and no material applied to the trunk can be taken into the sap of the tree or injure any pest.

REPORT OF THE ENTOMOLOGIST OF THE STATE BOARD OF AGRICULTURE.

Mr. Chairman, Officers and Members of the State Board of Agriculture:

To me falls the duty of rendering to you a report of the entomological conditions in Pennsylvania during the year 1907. I have no way of knowing how much of my correspondence and service regarding insects is due to my position with this Respected Board, but I know that in the capacity of Economic Zoologist of this Commonwealth our chief correspondence, publications and practical work has been along this line. We have, therefore, been in position to watch closely the outbreaks of injurious insects, the remedies that have been used successfully or otherwise in their repression, the enemies of insects and the appearance of literature upon this subject as well as the undoubtedly increased attention given it by the public.

We rejoice to say that with our other insect troubles, we have not been invaded with such destructive pests as the West Indian Peach Scale, the Brown Scale, the Gypsy Moth and the Brown Tail Moth. While we recognize the serious effects of the San José Scale and the great havoc it has played in this State we are certain that the conditions would be much worse were any one or more of the above named pests to be established within this Commonwealth. Therefore, it is important that we watch for them and guard carefully against their introduction, and should they become established it is necessary to take all possible means of stamping them out at once.

The worst pest, of course, attacking vegetation in this State is the San José Scale, which has been responsible for the destruction of millions of dollars' worth of fruit trees, and which is causing

an annual loss of hundreds of thousands of dollars' worth of property in the State and reducing our fruit and fruit prospects. In many of the large fruit-growing districts two or three years ago nearly all the horticulturists were discouraged with it and ready to quit, but we are pleased to be able to report that now they have taken new courage and are producing almost perfect fruit in spite of the presence of the San José Scale. They are learning to keep such pests in check by the most simple, cheap and efficient remedies.

Where there is a great demand there will eventually appear a great supply. This State has experienced a very urgent demand for an effective and convenient insecticide. As a consequence, materials of many kinds have been placed upon the market. While we can not discuss here in detail the various remedies for the San José Scale, it appears important for us to say that it has been demonstrated beyond doubt that the best and cheapest remedy for this pest is the Lime-sulphur Wash:

17 pounds Lime, 22 pounds Sulphur, Water to boil an hour, boil, strain and add water to make 50 gallons, and spray by giving two good coats over all the bark.

Fortunately, two or three companies are now making commercial preparations of the Lime-sulphur Compound, which are effective and which although costing a little more than the home-made Lime-sulphur Wash are not nearly as expensive as the commercial oil preparations now on the market, and this has the additional advantage over the oils of beings a fungicide as well as an insecticide. It is our pleasure to report that the material made and sold as "Ska-Kill," at Waynesboro, Pa., has been withdrawn from manufacture and sale. It has proven entirely inefficient and unsatisfactory, as we indicated it would, and demonstrated it by actual test. We hope to see all commercial materials that fail to give satisfactory results properly exposed, in order that purchasers may act intelligently in attempting to suppress pests with such insecticides. For this reason, we deem it necessary to call attention to one of the so-called soluble oil preparations sold under the name of "Target Brand," made at Martinsburg, W. Va., which is reported to us from different sources as having resulted in the destruction of trees to which it was applied. It is important for our practical fruit growers to know that such unfortunate results have been obtained by their brother horticulturists and are liable to recur at any time and place.

Attention should be called to the experiments which have been conducted by the Division of Zoology of the State Department of Agriculture and of which publication has been made in the

Monthly Bulletin of said Division. Practically all insect pests in this State have been therein discussed and formulæ for suppressing the same have been published in the May, June and July numbers. These may be obtained free by writing for them. Also the various Experiment Stations and the U. S. Department of Agriculture have published extensively upon entomological topics, and persons interested may obtain literature without charge upon almost any topic he may desire.

Upon the insects concerning which we have had considerable correspondence in this State during the last year are the following:

Ants on lawns, in houses, in cornfields, attending aphids or plant lice, on fruit trees, and otherwise. We have shown that ants in lawns can be destroyed by making holes in the ground reaching to the bottom of their nests and into each hole pouring a half teaspoonful of Carbon Bisulfid. From houses they are best exterminated by tracing the path or line they follow to their nests and pouring benzine or gasoline into the nest to destroy the queen. Ants in cornfields, in the spring, have proven annoying, not by their direct injury, but by taking care of the plant lice which infest the roots of corn plants and prove quite obnoxious. To overcome this it is best to plow the ground in the fall, and cultivate it as late as possible until it freezes, and in the early spring cultivate again with a spring-toothed harrow, then harrow it later and plant the corn late after having kept down the weeds and grass of early spring. Many persons see the ants on trees or shrubs and ask for a remedy. It is not the ants that should be remedied, but the plant lice, which are attracting these little insects. Many ants are seen going up and down trees, and it may almost always be taken that it is because either plant lice or scale insects are present on the branches or leaves of the trees, and by the sweet secretions called honey dew, they are furnishing food to the ants. Contact insecticides ridding the trees of suctorial pests will soon result in the disappearance of the ants.

Aphids and plant lice have been the subject of a great deal of correspondence. They are especially liable to appear upon the leaves of trees during the early summer and cause these leaves to become deformed or twisted out of shape. Within the leaf and upon the branches beneath them, as well as upon the ground, are often found glistening or shiny drops and rather black sooty spots. These shiny drops looking like honey are called honey dew, and the dark spots are the results of a fungus developing in the honey dew. The best remedy for plant lice is to spray with contact insecticides, such as one pound of whale oil soap dissolved in six gallons of water, applied just as the buds are bursting, or

the Lime-sulphur solution applied as for San José Scale, applying it after the buds swell and just when the first of them commence. to burst and show green. We have sprayed trees with the green leaves quite apparent and the pink of the blossoms commencing to show, and have killed the scale insects and plant lice without injury to the leaves or fruit. The Lime-sulphur regularly recommended was used for this.

The apple aphis passes the winter in the form of eggs on the branches of the trees, and is thus easily reached by a good contact insecticide. I have also had very positive reports of the cherry aphis, sometimes called the brown plant lice, having been destroyed by the spring application of the Lime-sulphur Wash for San José Scale.

In some portions of this State the Green Louse or Plant Louse on the potato has been so abundant as to have proven destructive, but it can be held in check by spraying with Whale Oil Soap Solution or strong Decoction of Tobacco or eight per cent. Kerosene Emulsion.

The Gray Maple Aphis has caused a great deal of alarm by its appearance on the under sides of Norway maple shade trees along streets, and causing the leaves to fall abundantly about midsummer. While this was unusually abundant during the past year, we do not generally consider it such that it is necessary to take practical steps for its control, but if such should be thought necessary, it should be sufficient to spray thoroughly with a mild contact insecticide.

The Wooly Aphis is a very serious orchard pest. This little bluish-white Plant Louse is to be found in most orchards where the bark has been slightly injured. It attacks the branches, the trunk or the roots. By looking around the edge of the injured spot a bluish-white ring may be often seen. Upon examination this is found to consist of these little pests, sometimes looking as though covered with flour. It is best to treat them either by spraying or by washing the injury with a brush dipped into a mixture of pure White Lead and Linseed Oil or a very strong solution of Soap or Soft Soap. Where this occurs upon the roots of trees, it is advisable to bury an abundance of Tobacco Dust around the roots. This not only acts as a very good orchard fertilizer, being worth about at least twenty dollars per ton for this purpose, but also acts as a valuable insecticide in destroying such pests as Wooly Aphis and other root-infesting insects.

Bagworms have attracted considerable attention by their unusual numbers and destruction of foliage, but as these are so easily seen while the trees are dormant, and so easily killed, both by

hand picking at that time, and by spraying with Arsenical Poisons after the leaves appear, there is no reason why injury should be experienced by this pest.

Household pests, such as Cockroaches, Bedbugs, Flies, Fleas and other insects, have been the subject of much inquiry, and have been controlled satisfactorily, and in fact in many houses were entirely exterminated by thoroughly and properly fumigating with Hydrocyanic Acid Gas. There is no reason why one should suffer from such pests after having been informed of the efficiency and ease with which they can be exterminated.

The subject of bees and Bee-keeping has received considerable attention from the members of the State Bee-Keepers' Association and others, and several persons have tried Bees of the various races. It is generally accepted that the Italian is the standard race of bees known to American bee-keepers at present.

Among Beetles, the Asparagus Beetle has been extending its range over the State, but as this is easy to keep in check by dusting with freshly slaked lime, or with flour and Paris Green, one part of the poison to forty parts of Flour, there is no reason why it should be very destructive. The Striped Cucumber Beetle was abundant and injurious in most parts of this State, but is prevented chiefly by covering the plants with netting until the vines start to run.

The unquestionably good effects of Lady Beetles as destroyers of obnoxious insects, and especially of young Scale Insects and Plant Lice, are noted many times. Also the value of the Ground Beetles as predaceous insects in destroying larvæ and other insects.

Bark Beetles have continued to bore their little round holes through the bark of trees that are declining and hasten their death, giving the appearance of having been in many cases the sole cause of the trouble. It is to be remembered that wherever a branch is dying through having become broken or otherwise, the Bark Beetle is ready to attack it, and oftentimes we see the work of the Shot-Hole Borer, and as this is in a tree that is already dead or dying, we think it is more destructive than the facts warrant. If trees are so declining as to be attacked by the Shot-Hole Borers, they should be cut and burned, and thus prevent the spread of the pests to other trees.

Borers of fruit trees have been unusually active, but the fruit growers have had another year to test the efficiency of pure Linseed Oil and White Lead used as paint, applied during the early part of the summer to prevent such pests as well as later ravages by Rats and Mice. We have seen thousands of apple trees so painted and no injury has come. In fact we have tried it on our

own peach trees, and although this was done last summer, we can not yet report injury, yet we still call attention to the fact that the Peach-tree Borer is an insect that works lower in the ground, and is not to be prevented by this method. Therefore it is scarcely necessary to paint any but apple, pear and quince in order to prevent the attacks of Borers. The Peach Twig Borer has occurred in this State as a comparatively new pest. It is to be destroyed by the regular formula for spraying with the Lime-sulphur Wash for the San José Scale and at the same time of year as recommended for this pest.

The Borer in potato plants and many other forms of vegetation has proven quite destructive and has attracted considerable attention. Since this lives chiefly in large weeds or rushes, like bull weeds and artichokes, it is very important to destroy these larger weeds by mowing them two or three times during the summer. This pest can then be kept in check by thorough cultivation of plants and by burning as soon as they appear to wilt from the effects of its infestation.

The Cabbage Root Maggot has been unusually severe and has destroyed much of the early planted cabbage as well as turnips and radishes. Our experiments have proven that it is best to prevent this by putting a band or disk of tarred paper around the plant at the time it is set. These can be cut very rapidly with a punch somewhat like a wad cutter for gun wads. They should be nearly ten inches in diameter and slit in the centre to let them be passed around the plant. If plants be not thus protected and later be infested with the Rootworm, this pest can be killed by treating with Carbolic Emulsion as discussed in the Monthly Bulletin of the Economic Zoologist for March, 1907. Fortunately, the late cabbage is not infested with this pest as much as is the early planted, and therefore, it is recommended to plant late that which is needed for the winter supply and for making sourkraut and the chief family use of the year.

The Green Worm or Larvæ of the White Butterfly has not been known to be so destructive during the past year for the reason that the more extensive gardeners and truckers have now learned to control it by simply spraying with Arsenate of Lead or Paris Green applied at any time when the pests are present and before the heads are three-fourths grown. Also dusting with Flour and Paris Green while the leaves are damp with dew will prove effective. Use one part of Paris Green to forty parts of Flour. We know where poisons have been used on cabbage for this pest for years without evil results.

Cabbage Plant Lice have proven quite destructive and should

be killed by spraying with Whale Oil Soap, one pound in six gallons of water, or similar insecticides as recommended for Aphids.

The Curculio has been as abundant as ever on peash, plum, cherry and quince, but is being held in check by many orchardists by spraying with Arsenate of Lead in Bordeaux Mixture and combining this with jarring of the trees in the morning to catch the pests.

A few correspondents reported Cutworms in abundance, but this was only on sod ground, and where the ground was plowed in the fall and the insects exposed by late fall and early spring cultivation, they were not found so destructive. Also their experiments in using poisoned bran for these pests were very successful, as was published in one of our Bulletins for last spring.

The European Fruit Scale, Forbes' Scale and Putman's Scale are species of the genus Aspidiotus, thus belonging to the same genus as the San José Scale and closely resembling the last-named pest. They have been found very extensively by our inspectors and it is not infrequent that an error is made by confusing these with San José Scale. They are not so destructive and need not cause undue alarm.

Flea Beetles have been present and especially destructive on potatoes by gnawing holes in the epidermis and making the leaves appear to be specked with brown. However, they are repelled or destroyed by spraying with Bordeaux Mixture with an Arsenical poison added.

The grain pest known as the Angoumois Grain Moth has continued its destructiveness, especially in the Southeastern portion of this State. However, we have had some excellent reports of loss prevented by this pest by threshing the grain early and getting it into the bin rather than leaving it in the straw. One person in particular reported to us that he had threshed about one-half of his crop shortly after harvest and the other half was left until the early part of the winter. The former was not injured by the Grain Moth, while the latter was practically destroyed. This is in accordance with our recommendations.

Grasshoppers have been observed by us as serious enemies of fruit by gnawing peaches through the skin at the upper side as they are ripening, especially during the very dry part of the year which, of course, is the growing side, and resulting in decided blemishes. We have also had reports of their destroying tobacco and eating the leaves and fruit of melons. We recommend poisoning them with the Criddle Mixture or spraying with sweetened arsenical poison. The Criddle Mixture is discussed in the Bulletin of the Division of Zoology for last May.

The Hessian Fly has not been so destructive as during some

years, but as usual the wheat planted early has been generally infested more or less.

Lady Beetles as beneficial insects have been reported from a great many different sources. Leaf Hoppers on rose, apple and potatoes have been injurious in some places, but have been destroyed by two or three applications of contact insecticides, such as are recommended for Plant Lice. Maggots or the larvæ of the Flies in raspberry canes have appeared in some parts of this State, thus causing a wilting down of the tips during the summer. They should be cut and burned when found infested. The Mediterranean Flour Moth has been destructive in mills and graneries in the Eastern parts of this State, and it has also spread to the extreme Northern or Western portions of the State, but has been cleaned up satisfactorily by two fumigations at intervals of about one week with Hydrocyanic Acid Gas. In some of the larger mills this operation has cost over fifty dollars for the fumigation, but has given very satisfactory results in destroying all insects in the building as well as Mice and Rats by the bushel.

Mites, especially the Red Mites, have been reported injuring many varieties of trees, shrubs, ornamental plants and shrubbery, and have been controlled by spraying with the Lime-sulphur Wash, the same as for the San José Scale, or with contact insecticides containing Sulphur or Sulphur Compounds.

Slugs on cherry and pear trees have been very abundant and destructive, but easily killed by dusting with freshly-slaked Lime with about one-fortieth part of Paris Green added.

Spraying is becoming far more extensive than ever before and our citizens are producing better fruits, planting young orchards and having better results and a more hopeful outlook than has previously been known in this State.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907.

For each entry of which the species is determined a common specific or general name is given, followed by the scientific name. Following entries are given with the common name when that is specific, and with the scientific name when the common name is not specific name, allowing the contributor to follow the list back for the general name.

Number.	Specimens.	Date—September, 1907.	Name and Address.
	Insects.		
10609	18 species of insects,	3	K. Geist, Covington, La.
10611	Regal Moth larva (Citheronia regalis),	3	W. C. Wilson, Cochranville.
10612	Long-horned Grasshoppers,	3	Miss R. Cook, Harrisburg.
10613	Milkweed Butterfly Chrysalis (Danais plexippus),	3	B. M. Stone, Stull.
10614	Moth larvæ,	3	Miss G. Beebe, Odin.
10618	(a) Io Moth larva (Hyperchiria io), (b) Sphinx larva (Pholus pandorus),	3	S. M. Beecher, New Milford.
10619	7 species of insects,	3	S. Baldy, Catawissa.
10620	Chestnut Weevils (Balaninus sp.),	3	L. L. Springer, Edenville.
10621	4 species of insects,	3	Miss M. Gifford, Newton Hamilton
10624	(a) San José Scale (Aspidiotus perniciosus), (b) Scurfy Scale (Chionaspis furfurus),	3	Mrs. M. C. Sparks, Rainsburg.
10625	Flesh Fly,	3	R. J. Peschko, Camden, N. J.
10627	Magnolia Scale (Neolecanium cornuparvum),	4	C. S. Fouse, Mt. Union.
10628	Io Moth larvæ,	4	G. H. Huston, Ford City.
10629	Regalis Moth larva,	4	W. B. Henneberger, Greencastle.
10630	Regal Larva,	4	C. E. Fitch, Kemblesville.
10636	Meal Worm (Tenebrio molitor),	4	G. F. Brown, Grassflat.
10637	Cecropia larva (Samia cecropia),	4	J. Rauch, Harrisburg.
10638	Yellow Swallow-tail Butterfly (Papilio turnus) Black Form,	4	H. B. Jackson, Harrisburg.
10644	White Fly (Aleyrodes sp.),	5	———, Kennet Square.
10646	Scurfy Scale,	5	W. H. Price, Analomink.
10647	Sawfly larvæ,	5	V. O. Switzer, Danville.
10648	Long-horn Beetle (Orthosoma brunneum),	5	D. P. Carrier, Corry.
10649	Tomato Worm (Phlegethontius 5-maculata),	5	L. Dunkle, Robesonia.
10650	4 species of Beetles,	5	W. J. Mills, Atlanta, Ga.
10656	Ichneumon Wasps,	6	D. A. Claar, Queen.
10657	Cecropia larva,	6	Miss M. Hartzell, Lebanon.
10658	Regal Moth larva,	6	E. E. Borry, Stevens.
10660	Parasitic Digger Wasp (Discolia sp.),	6	W. H. Stout, Pine Grove.
10661	Cecropia Moths,	6	J. W. Minsker, Harrisburg.
10662	15-spotted Lady Beetle (Anatis ocellata),	6	Dr. Stewart, Independence.
10663	Warble from Cat,	6	Miss K. Bishop, Carlisle.
10664	(a) Saddle-back Caterpillar (Sibine stimulea), (b) Arctiid Moth,	6	G. and J. Landis, McCulloughs Mills.
10665	Regal Moth larva,	6	H. K. Walton, Christiana.
10666	Regal Moth larva,	6	D. K. Heckendorn, New Bloomfield.
10669	Yellow Swallow-tail Butterfly Larvæ,	7	A. O. Apker, Penfield.
10670	Hag Moth larva (Phobetron pitchecium),	7	L. L. Springer, Edenville.
10673	(b) American Giant Water Bug (Belostoma americanum), (c) Eyed Elater (Alaus oculatus), (d) Long-horned Grasshopper,	9	W. H. Bullock, Honesdale.
10677	Oyster-shell Scale (Lepidosaphes ulmi),	9	Miss E. W. Collins, Swarthmore.
10679	Imperial Moth larva (Eacles imperialis),	9	G. A. Davies, Lansford.
10680	White Fly,	9	W. M. Robinson, Danville.
10682	Plant Lice,	9	A. W. Crownover, Greensburg.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10683	Mole Cricket (Gryllotalpa sp.), ...	9	A. C. Peters, Montgomery.
10685	Regalis Moth larva, ...	9	J. L. Bowman, Camp Hill.
10687	(a) Rose Scale (Aulacaspis rosæ), (c) Work of Cucumber Beetles (Diabrotica sp.), ...	9	O. Sloat, Manchester.
10691	Regal Moth Larva, ...	9	Mrs. Montgomery, Penbrook.
10696	White-spotted Skipper, larva and cocoon (Eudamus tityrus), ...	10	Mrs. W. B. Mehaffie, Duncannon.
10697	Regal Moth larva, ...	10	A. Burgess, Glenmore.
10699	7 species of insects, ...	10	R. I. Myers, Welty.
10700	(a) Bagworm Cocoons (Thyridopteryx ephemeraeformis), ... (b) Tussock Moth larvæ (Hemerocampa leucostigma), ...	10	W. H. Stout, Pine Grove.
10701	Cicada, ...	10	J. C. Colegrove, Gaines.
10702	Flannel Moth larvæ (Lagoa crispata), ...	10	S. P. Garber, Kerrsville.
10703	Mole Cricket, ...	10	W. O. Woodring, Chicora.
10704	Jumping Plant Lice (Psyllidæ), ..	10	T. W. Way, West Chester.
10705	Squash Bug (Anasa tristis), ...	10	C. H. Groff, Berwyn.
10706	Plant Lice, ...	10	Miss R. Mackall, Beaver.
10707	Work of Ants, ...	10	Dr. I. M. Weills, Harrisburg.
10709	5 species of insects, ...	11	E. W. Walp, Pen Argyl.
10712	Fly Larvæ, ...	11	W. M. Sharrer, Cherry Tree.
10713	(a) Luna Moth larva (Actias luna), ... (b) Prominent Moth larva (Datana integerrima), ...	11	G. W. Brown, Sabula.
10714	Pholus pandorus larva, ...	11	M. G. Hill, Rush.
10715	Leopard Moth larva (Ecpantheria deflorata), ...	11	A. B. Miller, Barnesville.
10716	Tomato Sphinx Larva with microgaster parasites, ...	11	W. O. Bishop, Harrisburg.
10717	Imperial Moth larva, ...	11	J. M. Drum, Mercersburg.
10722	San José Scale, ...	12	H. Maurer, New Berlin.
10723	Oyster-shell Scale, ...	12	D. P. Gerberich, Lebanon.
10724	Regal Moth larva, ...	12	J. M. Cruil, Landisburg.
10725	(a) San José Scale, ... (b) Scurfy Scale, ...	12	F. G. Wolfe, Bangor.
10727	Dogday Cicada (Cicada tibicen), ..	12	Mrs. S. A. Craig, Brookville.
10729	Parasitic Wasps (Thalessa lunator), ...	12	A. E. Westbrook, Knoxville.
10730	Crane Fly (Tipula abdominalis), ..	12	G. R. Styer, Berwick.
10741	Milkweed Butterfly, ...	12	J. Raver, Harrisburg.
10742	(a) Yellow-necked Datana (Datana ministra), ... (b) Red-humped Apple Worm (Schizura concinna), ...	13	J. W. Wagner, New Florence.
10744	(a) Cecropia larva, ... (b) Celery Worms (Papilio polyxenes), ...	13	W. Jones, Old Forge.
10745	5 species of insects, ...	13	H. H. Stevens, Enid.
10746	(a) Regal Moth larva, ... (b) Cecropia larvæ, ... (c) Luna Moth larvæ, ...	13	D. K. Heckendorn, New Bloomfield
10747	Under-wing Moth, Catocala sp., ..	13	C. Anderson, Harrisburg.
10750	(a) Dragon Flies, ... (b) Cicada, ...	14	R. C. Beaver, Greenville.
10752	(a) Bagworm Cocoon, ... (b) Tipula abdominalis, ...	14	Miss F. E. Wagner, Mechanicsburg.
10757	Short-horned Grasshopper (Schistocerca americana), ...	16	Miss M. Edwards, Harrisburg.
10758	Bagworms, ...	16	A. Reichenbach, Collegeville.
10760	Cicada, ...	16	E. J. Baird, Lock Haven.
10761	Chestnut Weevils, ...	16	L. L. Springer, Edenville.
10762	(a) Nerve-veined Insects (Neuroptera), ... (c) White-flies, ...	16	G. W. Mayberry, Holmesburg.
10768	Parasitic wasp (Thalessa atrata), ..	16	Miss A. H. Tompkins, Pittston.
10769	Sphinx Larva (Sphinx chersis), ...	17	F. Koenig, Harrisburg.
10770	Imperial Moth larva, ...	17	B. Converse, Granville Summit.
10771	Walking Stick (D. femorata), ...	17	J. E. Senft, Hanover.
10773	Cecropia Larva, ...	17	M. Halderbaum, New Paris.
10775	Fall Webworms (Hyphantria cunea), ...	17	E. R. Bruyate, Shippensburg.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10776	(a) Oak Worm (Anisota senatoria), (b) Regal Moth larva, (c) Io larva,	17	H. A. Brightbill, Jr., Marsh Run.
10777	(a) Cecropia Moth, (b) Imperial Moth, (c) Giant Water Bug (Benacus griseus),	17	I. F. Mansfield, Beaver.
10778	Oyster-shell Scale,	17	J. W. Grimes, Claysville.
10779	Plant Lice,	17	O. T. Rentschler, Philadelphia.
10780	(a) Cicada, (b) Ground Beetle,	17	Miss H. Anthony, West Chester.
10782	Syrphid Flies,	17	J. Q. Keener, VanVoorhis, W. Va.
10783	Crane Fly larvæ,	17	H. M. Hoffman, Vogansville.
10784	Saddle-back larva,	17	G. C. Jack, Harrisburg.
10790	Prominent Moth larva (Melalopha inclusa),	18	W. H. Smith, Schuyler.
10792	Imperial Moth larva,	18	S. M. Robinson, McConnellsburg.
10793	Milkweed Butterfly Chrysalis,	18	H. C. Reinhold, East Petersburg.
10794	Io Moth larva,	18	P. Hanson, Erie.
10795	(a) Scurfy Scale,	18	E. F. Phillips, Tower City.
10796	Thalessa atrata, (b) Mole Cricket,	18	P. K. Moore, Trent.
10799	(a) San José Scale, (b) Scurfy Scale,	18	S. G. Sarver, Newport.
10800	Mole Cricket,	18	W. H. Paxson, Lahaska.
10801	(a) Plant Lice, (b) 2-spotted Lady Beetle (Adalia bipunctata),	18	E. E. Wells, Wilkes-Barre.
10802	9 species of insects,	19	S. Baldy, Catawissa.
10804	(a) Oyster-shell Scale, (b) San José Scale,	19	W. L. Stevenson, McVeytown.
10805	Katydid (Cryptophyllus perspicillatus),	19	L. S. Foulk, Schuyler.
10806	(a) Io larva, (b) Tussock Moth larva,	19	J. W. Fryling, Sunbury.
10807	Regal Moth larva,	19	W. D. Morton, Concordville.
10808	Plant Lice,	19	W. Motter, Altoona.
10810	Cicada,	19	Miss L. Pritchard, Harrisburg.
10812	Regal Moth larva,	19	J. S. Shuman, State Line.
10813	Tomato Sphinx,	19	N. Lambert, Harrisburg.
10814	San José Scale,	19	E. R. Klinedinst, Mechanicsburg.
10818	(a) Io Moth larva, (b) Regal Moth larva, (c) Cicada,	20	Dr. J. B. Kalbfus, Harrisburg.
10819	Tussock Moth larva,	20	H. Simpson, Edgerly.
10820	Tomato Sphinx,	20	L. A. Boyce, Drumore.
10821	(a) Plant Lice, (b) Lady Beetle (Hippodamia convergens),	20	W. H. Hoerner, Saginaw.
10822	Katydid (Amblycorypha oblongifolia),	20	G. N. Peifer, Sinking Springs.
10823	Saddle-back Caterpillar,	20	M. E. Davis, Norristown.
10824	Cecropia Cocoon,	20	J. E. Dickey, Olivedale.
10830	(a) Larva of Midges (Chironomidæ), (c) Lepidoptera eggs, (d) Lepidoptera larvæ,	21	H. K. West, Danville.
10833	(d) Caddis Fly cases, (e) Microlepidoptera and cocoons,	23	G. B. Sims, Cherry Tree.
10835	7 species of insects,	23	Prof. I. L. Kinney, Portland.
10836	Milkweed Butterfly Chrysalis,	23	Miss L. A. Hickok, Bedford.
10837	Cicada,	23	J. B. Zigner, Harrisburg.
10838	4 species of insects,	23	Miss F. E. Wagner, Mechanicsburg.
10839	Io Moth larva,	23	A. B. Miller, Barnesville.
10840	Cicada,	23	W. A. Warner, Stickney.
10841	(a) Plant Lice, (b) Arctiid Moth larva, (c) Bagworm cocoon,	23	G. W. Mayberry, Holmesburg.
10842	10 species of insects,	23	A. H. Stevens, Enid.
10845	Hag Moth,	24	R. E. Beuchoff, Lemasters.
10846	Ecpantheria deflorata,	24	J. H. Zeigler, Redhill.
10847	Blister Beetle (Meloe americanus),	24	F. W. Peiffer, Fishers Ferry.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10848	Hag Moth,	24	W. H. Ramsey, Coraopolis.
10849	Pholus pandorus larva,	24	D. N. Kern, Allentown.
10850	(a) Pigeon tremex (Tremex columba), (b) Stink Bugs, (c) Plant Bugs (Capsidæ),	24	L. B. Gilmore, Saegertown.
10851	(a) Polyphemus larva, (b) Arctiid larva, (c) Moth larva,	24	Miss J. E. West, Danville.
10852	False Maple Scale (Phenacoccus acericola),	24	I. F. Mansfield, Beaver.
10853	Mole Cricket,	24	J. Caldwell, Chambersburg.
10854	Silver Fish (Lepisma sp.),	24	Miss A. M. Fretz, Sellersville.
10855	(a) San José Scale, (b) Leaf Hoppers (Jassidæ),	24	J. H. Hollingworth, Wallingford.
10856	(a) Drone Fly (Eristalis tenax), (b) Butterfly (Argynnis sp.),	24	A. B. Miller, Barnesville.
10857	(b) Psocids,	24	Mrs. M. M. Powers, Harrisburg.
10858	(c) Short-horned Grasshopper, (d) Roach, (e) Long-horn Beetle (Prionus laticollis),	25	L. A. Gibson and W. O. Woodring, Chicora.
10860	(a) Yellow Swallow-tail Butterfly larva, (b) Cicada,	25	A. B. Myrick, Leolyn.
10861	Plant Lice,	25	J. Middendorf, Wyalusing.
10863	Luna Moth larva,	25	A. B. Miller, Barnesville.
10864	Cecropia Moth larva,	25	F. Glaser, Harrisburg.
10865	Tomato Sphinx Pupa,	25	J. E. Dezler, Tulpehocken.
10872	Imperial Moth larva,	26	L. M. Dunkle, Robesonia.
10873	(a) Sphinx pupa, (b) Moth pupa, (c) Butterfly Chrysalis,	26	F. A. Degler, Cheat Bridge, W. Va.
10874	5 species of insects,	26	Mrs. J. W. Atkinson, Buckingham.
10876	Regal Moth larva,	26	A. S. McGinity, Marion Centre.
10877	Cecropia larva,	26	E. J. Baird, Lock Haven.
10878	Cicada,	26	C. Moselein, Harrisburg.
10886	Cecropia larva,	27	E. J. Nicholas, Mt. Bethel.
10887	Bagworm cocoons,	27	J. A. Reeser, West Leesport.
10888	Locust Borer (Cyllene robiniae),	27	B. S. Bowdish, New York.
10889	Cicada,	27	Miss K. E. Lehman, Coudersport.
10890	Red-humped Apple Worm,	27	C. T. Harbaugh, Sewickley.
10895	Saddle-back Caterpillar,	28	Miss E. M. Strite, Greencastle.
10896	Celery Worm,	28	R. H. Wolf, Sunbury.
10900	Regal Moth larva,	30	F. Decker, Saluvia.
10901	(a) Red-humped Apple Worm, (b) Yellow Swallow-tail Butterfly	30	C. F. Hayes, Curwensville.
10902	Saddle-back larva,	30	H. R. Miller, Robesonia.
10903	Cecrophia larva,	30	J. C. Colegrove, Gaines.
10904	(a) Moth pupæ, (b) Spotted Grape Leaf Chafer,	30	A. C. Spangler, Selinsgrove.
10905	Papilio troilus,	30	E. P. Miller, Altoona.
	Invertebrates not Insects.		
10609	(q) Spider,	3	K. Geist, Covington, La.
10616	Spider,	3	M. L. Sheetz, Stoverdale.
10659	Centipede,	6	M. L. Goss, Altoona.
10681	Slug,	9	E. S. Black, Little Silver, N. J.
10725	(c) Mites,	12	F. G. Wolf, Bangor.
10728	Lycosid Spider,	12	H. C. Aaron, Kingsville.
10743	Hair Worm (Gordius sp.),	13	E. H. Alberty, Dyberry.
10745	(b) Hair Worm, (g) Lycosid Spider,	13	A. H. Stevens, Enid.
10759	Mites,	16	F. M. Bream, Gettysburg.
10762	(b) Mites,	16	G. W. Mayberry, Holmesburg, Phila.
10798	Mites,	18	B. W. Heberly, Utahville.
10817	Bass Worms,	20	W. J. Sheldon, Springboro.
10835	Crayfish,	23	Prof. I. L. Kinney, Portland.
10857	(a) Centipede,	24	Mrs. M. M. Powers, Harrisburg.
10858	(f) Millipede,	25	L. A. Gibson and W. O. Woodring, Chicora.
10859	(a) Centipedes, (b) Millipedes,	25	L. A. Gibson, Chicora.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
	Reptiles and Batrachians.		
10605	Ring-necked Snake (Diadophis punctatus),	3	J. F. Reisinger, Ickesburg.
10606	Common Water Snake (Natrix sipedon),	3	F. A. Shaw, Wellsboro.
10607	Ring-necked Snake,	3	D. H. Bauman, Mance.
10608	(a) 3 Mud Turtles (Kinosternon pennsylvanicum), (b) Bull Frog (Rana catesbeana), (c) 3-Toed Box Tortoise (Terrapene triunguis),	3	K. Geist, Covington, La.
10610	Granite Salamander (Plethodon glutinosus),	3	E. S. Seaman, Wilmore.
10623	Common Garter Snake (Thamnophis sirtalis),	3	E. H. Weik, Kleinfeltersville.
10635	Common Water Snake,	4	J. F. Reisinger, Ickesburg.
10641	Blacksnake (Bascanion constrictor),	5	F. G. Couch, Andersonburg.
10642	Sculptured Turtle (Clemmys insculptus)	5	A. F. Seaman, Wilmore.
10643	Red-bellied Snake (Storeria occipitomaculata),	5	Mrs. R. S. Hampton, Titusville.
10653	Blacksnake,	5	T. A. Berkey, Easton.
10654	Eggs of Blowing Viper (Heterodon platirhinos),	6	K. Geist, Covington, La.
10667	Box Tortoise (Terrapene carolina),	6	J. Lawrence, Coatesville.
10672	Copperhead Snake (Agkistrodon contortrix),	9	H. M. Raal, Dallastown.
10673	(a) 2 Purple Salamanders (Gyrinophilus porphyriticus),	9	W. H. Bullock, Honesdale.
10674	(a) 3 Soft-shelled Turtles (Aspidonectes spinifer), (b) Common Box Tortoise,	9	R. W. Wehrle, Indiana.
10675	3 Common Garter Snakes,	9	A. W. Smith, Blairsville.
10676	2 Common Garter Snakes,	9	A. W. Smith, Blairsville.
10684	2 Rock Snakes (Storeria dekayi),	9	R. Rogers, Karns City.
10693	Varied Treetoad (Hyla versicolor),	10	G. J. Wimmer, Nazareth.
10694	4 Opaque Salamanders (Amblystoma opacum),	10	I. R. Berry, Coatesville.
10708	Common Water Snake,	11	R. Sebring, Farrandsville.
10709	(a) Common Water Snake, (b) Spotted Salamander (Amblystoma punctatum), (c) 2 Newts (Diemictylus viridescens),	11	E. W. Walp, Pen Argyl.
10710	Pilot Snake (Callopeltis obsoletus),	11	A. W. Smith, Blairsville.
10720	2 Painted Turtles (Chrysemys picta),	12	S. Baldy, Catawissa.
10721	Common Garter Snake,	12	Prof. I. L. Kinney, Portland.
10726	Purple Salamander,	12	C. E. Dietterich, West Pike.
10731	Common Water Snake,	13	J. V. Kline, Huntingdon.
10734	2 Purple Salamanders,	13	J. A. Mitchell, Punxsutawney.
10735	(a) 20 Brown Salamanders (Desmognathus fusca), (b) 4 Land Salamanders (Plethodon cinereus), (c) Red Salamander (Spelerpes ruber), (d) 2-lined Salamander (Spelerpes bilineatus), (e) 3 Immature Salamanders,	13	Miss H. D. King, Bryn Mawr.
10736	Common Water Snake,	13	C. Barber, Apollo.
10737	Brown Salamander,	13	S. D. Kinney, Yardley.
10739	Opaque Salamander,	13	H. A. Brightbill, Marsh Run.
10048	Pilot Snake,	14	J. R. Derr, Sunbury.
10749	Brown Salamander,	14	G. L. Taylor, Wellsboro.
10754	Red-bellied Snake,	16	W. O. G. West, Danville.
10755	(a) 16 Brown Salamanders, (b) 2-lined Salamanders, (c) 8 Land Salamanders (d) Newt,	16	R. J. Simm, Jefferson, O.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10756	(a) Purple Salamander, ... (b) 3 Granite Salamanders, ...	16	I. Swartwood, Falls.
10767	Common Garter Snake, ...	17	J. Vallerchamp, Halifax.
10781	Common Box Tortoise and egg, ...	17	J. H. Zeigler, Redhill.
10785	Common Box Tortoise, ...	18	J. H. Wingert, Lewisburg.
10786	Grass Snake (Liopeltis vernalis),..	18	W. M. Sharrer, Cherry Tree.
10787	House Snake (Lampropeltis d. triangulus), ...	18	S. E. Pfeiffer, Harrisburg.
10788	Pilot Snake, ...	18	Prof. W. Y. Welch, Clarion.
10789	Hellbender (Cryptobranchus alleganiensis), ...	18	E. Parathemore, Harrisburg.
10815	3 Speckled Turtles (Clemmys guttatus), ...	19	W. H. Grim, Hamburg.
10816	(a) Common Box Tortoise, ... (b) Sculptured Turtle, ...	20	R. W. Wehrle, Indiana.
10825	Snake skin, ...	20	Miss M. MacKenzie, Philadelphia.
10827	Eggs of Blacksnake, ...	20	I. C. Elder, Chambersburg.
10829	Common Garter Snake, ...	21	E. E. Johnson, Lost Creek.
10830	(a) Granite Salamander, ...	21	H. K. West, Danville.
10831	(a) 4 Brown Salamanders, ... (b) 1 Purple Salamander, ...	21	Miss G. A. Beebe, Odin.
10833	(a) Granite Salamander, ... (b) Newt, ... (c) Brown Salamander, ...	23	G. B. Simms, Cherry Tree,
10835	(a) Hoptoads (Bufo l. americanus), ... (b) Green Frog (Rana clamitans) (c) 2 Meadow Frogs (Rana palustrus), ... (d) Painted Turtle, ... (e) 2 Common Garter Snakes, ... (f) 3 Land Salamanders, ... (g) 3 Brown Salamanders, ...	23	Prof. I. L. Kinney, Portland.
10843	Hoptoad, ...	24	E. P. Hipple, Mechanicsburg.
10844	(a) Newt, ... (b) Brown Salamanders, ...	24	L. V. Workman, State College.
10881	7 Common Garter Snakes, ...	27	H. Schaeffer, Harrisburg.
10882	House Snake, ...	27	F. G. Couch, Andersonburg.
10883	2 Common Water Snakes, ...	27	J. H. Clough, Montrose.
10884	Common Water Snake, ...	27	J. A. Shupp, Gilbert.
10892	2 Ground Snakes (Carphophiops amoenus), ...	28	Mrs. C. Mellott, Sipes Mills.
10897	Red Salamander, ...	30	B. W. Bohn, Robesonia.
10898	Blacksnake, ...	30	H. H. McGinnis, Parkers Landing.
10899	Blacksnake, ...	30	W. D. Dixon, St. Thomas.
	Birds and Mammals.		
10633	Common Weasel (Putorius noveboracensis), ...	4	J. A. Jefferson, Easton.
10668	Brown Bat (Vespertilio fuscus), ..	6	T. McNew, Harrisburg.
10692	Red Bat (Lasiurius borealis), ...	10	R. Silverthorn, North Springfield.
10732	Ruby-throated Hummingbird (Trochilus colubris), ...	15	Dr. J. L. R. Heichbold, Clearfield.
10733	Short-tailed Shrew (Blarina brevicauda), ...	18	A. B. Miller, Barnesville.
10738	Red-shouldered Hawk (Buteo lineatus), ...	13	Frank Green, Jr., Graceton.
10753	Raccoon (Procyon lotor), ...	14	G. H. Williams, Blossburg.
10766	Sharp-shinned Hawk (Accipiter velox), ...	17	W. F. Shafer, Cogan Sta.
10834	Sharp-shinned Hawk, ...	23	Prof. I. L. Kinney, Portland.
10862	Carolina Rail (Porzana carolina)...	25	R. W. Wehrle, Indiana.
10893	Rose-breasted Grosbeak (Hedy meles ludoviciana), ...	28	W. W. Climenson, Honeybrook.
10894	Horned Grebe (Columbus auritus).	28	F. W. Lehman, Coudersport.

SPECIMENS RECEIVED DURING JANUARY, 1908.

Number.	Specimens.	Date—January, 1908.	Name and Address.
	Insects.		
11241	Hemisphaerical Scale (Saissetia hemisphaerica),	3	E. F. Sherman, Glen Lyon.
11243	Beetle larvæ,	3	A. D. Morganthall, Waynesboro.
11244	Greenhouse Scale (Chrysomphalus aonidum),	3	F. N. Floyd, Dillsburg.
11247	Common Lady Beetle (Megilla maculata),	8	I. S. Hartzler, Belleville.
11248	San José Scale (Aspidiotus perniciosus),	8	R. Archer, Picture Rocks.
11250	Scurfy Scale (Chionaspis furfurus),	11	———, Dreshertown.
11251	San José Scale,	11	N. H. Long, Greensburg.
11253	Scale insects (Diaspis caruelli),	13	W. H. Wolff, West Chester.
11254	2-spotted Lady Beetle,	14	J. A. Clarke, Berwyn.
11255	Scale insects (Eulecanium cerasifex),	15	W. C. Shepherd, Altoona.
11258	Oyster-shell Scale (Lepidosaphes ulmi),	20	W. Norris, Conshohocken.
11260	Katydid eggs,	20	J. H. Maurer, Manayunk.
11261	(a) Oyster-shell Scale,	20	D. J. Houck, Laanna.
11262	Oyster-shell Scale,	27	I. P. Pardee, Hazleton.
11264	San José Scale,	27	J. H. Zeigler, Red Hill.
11266	(a) Blister Beetle (Epicauta pennsylvanica), (b) Scurfy Scale,	27	F. R. Knecht, Nazareth.
11267	Life History Mount of Telea polyphemus moth,	27	C. W. Selden, Chicago, Ill.
11272	Eggs of Katydid,	30	A. C. Powell, Philadelphia.
11274	(a) Hemisphaerical Scale, (b) Greenhouse Scale (Hemichionaspis aspisdistræ), (c) White Flies (Aleurodes sp.),	30	———, Cheltenham.
11275	Collection of inflated Lepidoptera larvæ,	30	R. Dickson, Pittsburg.
	Invertebrates not Insects.		
11245	Nematode,	8	Miss P. F. Waterman, Centreville.
11252	Nematod,	11	C. M. Snelsire, Pittsburg.
11261	(b) Mites,	20	J. D. Hauck, Laanna.
	Reptiles and Batrachians.		
11259	Common Water Snake (Natrix sipedon),	20	R. W. Wehrle, Indiana.
11269	Brown Salamander (Desmognathus fusca),	28	E. S. Mattern, Allentown.
11270	Copperhead Snake (Agkistrodon contortrix),	28	Prof. S. C. Smucker, Downingtown.

THE ZOOLOGICAL BULLETIN

OF THE

DIVISION OF ZOOLOGY

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

VOL. V, No. 12.

SUBJECTS: Description of Insects and Their Work.
Insecticides.
Index.

April 1, 1908.

H. A. SURFACE, M. S., *Economic Zoologist, Editor.*

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Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

CONTENTS OF THE APRIL BULLETIN.

OUR MONTHLY CHAT WITH READERS.

This Bulletin. It may not seem proper for one to call attention to the results of his own efforts, but we can not refrain from saying to the citizens of Pennsylvania, that we consider this present issue, the best and most useful Bulletin of the sixty that have been published and issued from this office during the past five years. We have needed in this State some popular literature containing brief and accurate descriptions of insects and the work they perform, giving the common names of the insects in such a way that they may be recognized and their presence detected and proper remedies or preventives applied.

We have called attention to some comparatively new species of destructive insects in this State as well as some important imported plant diseases. It is very desirable that readers aid us by watching for the occurrance of these, in order that we may help to suppress them wherever they may occur in this Commonwealth. As serious as has been the loss by the San José Scale, amounting to millions of dollars in this State, we must honestly assure our citizens that there are pests and plant diseases of far greater destructive possibilities than this from which we have suffered so much. The scale scare and scale trouble should now be a thing of the past, as we have proven, by demonstrating how to control it satisfactorily and economically. For some of the other insects and diseases, however, more recently appearing, satisfactory remedies or preventives are not known. These yet remain as subjects for most important investigations. Let us work together!

THE DEMONSTRATION ORCHARDS.

The Demonstration Orchards that are now established in most of the Counties of this State are worthy of careful study by every person, growing even a few fruit trees. The pruning demonstrations have already been given, and where San José Scale is present the spraying demonstration for this pest has also been held. The Codling Moth demonstration will come next, and must be just after the blossoms fall. All citizens interested in good fruits should attend the demonstrations and see how to prevent wormy apples, pears

and quinces. Other demonstrations will be announced and given in due time. Watch the announcements in local papers.

How Late Can We Spray For Scale? Spraying for San José Scale can continue until after the buds burst and the green leaves appear and the pink of the blossom is first seen, but not after the blossoms commence to open. Do not spray any plants while in bloom unless it is desired to kill them.

This Bulletin will be sent while the supply is not exhausted to all persons in this State requesting it, and particularly to agricultural organizations and clubs of various kinds.

Correspondence on these topics is solicited. Send specimens and communications to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

INSECT PESTS AND THEIR WORK.

It is of great importance to know the names of insects that are effecting destruction to crops of various kinds. In many cases the pests themselves are not easily seen, but their work remains so apparent that growers are familiar with this rather than with the insects. It is our effort in this Bulletin to describe the appearance and effects of some of the most common and destructive insects, and also the pests themselves, in their destructive stages, in such a manner that the growers may be able to recognize the source of insect trouble and apply the known remedies for each, after determining the name of the pest or cause of the damage. It must be recognized that insecticides should vary in composition and time of application in accordance with the kind of insect for which they are to be applied. No fruit grower merely "sprays." He makes a careful study of the pests on his trees and applies the right material, at the right time, and in the right way to destroy, control or prevent these pests. The kind of insecticide to use, the proportions of materials necessary, the methods of making the mixture, the exact date of application, and the method of application, all are of fundamental importance and should be studied and learned. They have been discussed at length in previous issues of these Bulletins, a few copies of which yet remain in the office of the Economic Zoologist for free distribution to persons who need them.

Before the subject of insecticides, however, is that of the name of the pest for which the material is to be used. This really must be learned first. Every person going into the business of growing plants or keeping live stock, poultry or other living creatures of any

kind should first become acquainted with the diseases and enemies of those plants or animals. He should know them by name and by description, as well as by effects or results. By having this knowledge he can easily find the proper remedies or preventives in publications on such subjects.

In the following article, insects are discussed according to the plants they infest, but it must be remembered that some insects are liable to attack a great many varieties or species of plants, while others may be limited to but a few or even one only. When an insect like the Codling Moth is described under "Apple," this does not imply that it attacks no other fruits, and the description of its work for the fruit under which it is discussed is practically the same as for its effects on any other fruit or plant. If the description and name can not be found under one particular kind of fruit, it should be sought under another, which it may also attack. Details of remedies have been published in previous issues of these Bulletins, especially in our issue for last May, copies of which may be had by application to this office.

APPLE PESTS.

Aphids or Plant Lice: These are small, round-bodied greenish insects, with two long antennae or feelers and a piercing mouthpart by which they pierce the tissue of the leaf or growing twig and suck the juices, after having injected a saliva that is always poisonous and detrimental to the tree. Plant Lice belong to the group of insects without metamorphosis, and consequently they do not have a worm-like larval stage. The Apple Aphis remains during the winter in the form of black shiny eggs on the twigs of the tree. At this time spraying with such insecticides as are effective in killing scale insects will destroy them. About the time the buds are bursting the young Aphids hatch from the eggs and commence to suck the juices from the new green parts. This is the best time to kill them by mild contract sprays, such as dilute Whale Oil Soap, eight per cent Kerosene Emulsion, Tobacco Decoction, or dilute soap washes of other kinds. As they feed on the under sides of the leaves, the infested leaves become deformed or twisted and curled in such a way as to form protecting places for the insects within and sprays can not reach them. Consequently after the leaves are curled it is impossible to kill them by spraying, but if delayed until then the infested twigs may be bent over and dipped into pans containing the contact insecticide, or the leaves may be picked and destroyed.

The Codling Moth: The Codling Moth is the insect that feeds on the seeds and around the core of apples, pears and quinces. In its destructive stage it is a pinkish white larva which comes from an egg laid on the fruit or leaf by a small winged moth, which flies at night and is properly called the Codling Moth. This egg is laid about the time the trees are in bloom, and shortly after the flowers fall the little larva or worm hatches from the egg and generally crawls to the blossom end of the fruit, where it usually makes its entrance. There is no remedy for it after it has entered the fruit, but if a spray of arsenical poison be used at the right time, it will be killed with it when it takes the poison in attempting to gnaw through the surface of the fruit to reach the interior.

The best remedy is Arsenate of Lead, two or three pounds in fifty gallons of water, and the next best is Paris Green, one third pound in fifty gallons. Instead of using the poison in water alone, it is yet better to make the Bordeaux Mixture by the use of four pounds of Bluestone and six pounds of Lime and a fifty-gallon tank or barrel of water, and add the poison to this. For pears, apples and quinces this formula is all right, but for peaches and plums it should be reduced by using one-half of the materials in the full amount of water.

To prevent the further appearance of the Codling Moth, fallen fruits should be destroyed as soon as they drop, either by gathering them or by keeping pigs or sheep beneath the trees. Also, bands may be put around the trees in mid-summer to catch the larvae when they seek places to spin their cocoons and transform into their winged stage. However, if the bands be not examined at least once per week to kill the insects that collect beneath them they are worse than as though nothing had been used, for the reason that they will furnish hiding places for these pests rather than force them to transform where woodpeckers and other natural enemies would be liable to find and destroy them.

The spraying for the Codling Moth should be done just after the petals or flowers fall, and again in a week or ten days from that date. There are two broods of the Codling Moth per year, but if the spraying be thoroughly and properly done for the first brood it will not be necessary to spray in July or August for the second brood.

The Bud Moth: This is the insect which does its destruction when in the larval or worm stage by eating the interior of the buds of apple and other trees. The chief destruction is done in spring and may be quite serious, because the undeveloped leaves are then so small that one bite may cause deformity of an entire leaf as it further developes. For the Bud Moth, spray with Arsenate of Lead or

Paris Green as soon as the buds burst and the green leaves are showing, and repeat just before the blossoms open. Carefully avoid spraying blossoms when in bloom.

Bitter Rot: Bitter Rot, as a disease of the fruit shows itself in the form of dark-colored rotten spots, and causes the fruit in such spots to taste very bitter. It is important to prevent it by spraying with the Bordeaux Mixture before the blossoms open and again just after the flowers fall. This second Bordeaux spray is the spray with Paris Green added to be used for the Codling Moth. This Bordeaux spraying should be repeated once every ten days for a few weeks.

Borers: The Common Borers of Apple, Pear and Quince are the larvae or grubs that work beneath the bark of young trees. These generally enter and work where the bark has been injured or where the injury by sunscald has already started. They are rarely found in the branches and seldom in the trunks of large trees and perhaps never at the roots. There are two kinds of Borers attacking the growing trunks of young apple, pear and quince trees. One of these is called the Round-headed and the other the Flat-headed Borer. They are the larvæ or grubs of beetles belonging to different families. (These must not be confused with the Shot-hole Borer, discussed under "Peach.") Their presence is often made manifest by the dark, flattened, discolored spots in the bark over them. The bark is generally dark and flattened at such places, and tapping on it shows that it is hollow beneath. Sometimes they show evidences of their presence by means of holes cut through the bark and fresh "sawdust" dropping out. To get rid of them it is possible to cut them out after they have entered, or puncture them with a long, sharpened, but very soft, wire, which will follow their winding burrows, or drive sulfur matches into their holes and let them remain. It is also advisable to inject carbon bisulfide in their holes with a spring-bottom oil can and plug these with clay or mud. The best treatment for Borers of Apple, Pear and Quince is to prevent their entering the tree by painting with pure unboiled linseed oil and white lead, from the lower branches to the ground, about the last of June. This also prevents injury from mice and rabbits.

The Case Bearers: The Case Bearers are small insects which in their larval stage crawl over the leaves or twigs, carrying with them a small protecting case. In fact, there are two or three species of these Case Bearers, one of which carries a twisted tubular case and another carries a case shaped like a cigar, and hence is called the Cigar Case Bearer. It is impossible to spray them with contact insecticides because they are protected within their cases. They are killed by using poison sprays applied at the same time and in

the same manner as for the Bud Moth. The mature Case Bearer is a very small moth. Their injury is, of course, done in the larval stage, generally in the very early part of the growing season, and consists in eating holes in the leaves.

Canker Worms: The Canker Worm is sometimes called the Measuring Worm, Measurer, Loop Worm, Looper, "Tapeworm," and other common names. There are two species, one of which is called the Fall Canker Worm because they appear in the mature state in the fall of the year, and the other the Spring Cankerworm, because they live through the winter in the ground and transform to the adult state in the spring, and then crawl to and up the trees. The females are wingless and have no way of reaching the branches of the trees, where the eggs are deposited, other than to crawl from the ground to the twigs for this express purpose. While they are moths, they do not resemble moths in general from the fact that they are without wings, although the males have wings and fly readily from place to place. The larvæ are Measuring Worms that crawl along by looping during late spring, after having let themselves down from the trees by means of suspending silken webs. In Pennsylvania the Fall Canker Worms have, during recent years, been in the habit of remaining in the ground until spring and appearing at the time for the spring species.

They destroy the foliage of nearly all kinds of shade and fruit trees by eating it. They become full grown about the middle of June, when they disappear almost suddenly and enter the ground to pupate and remain during the remainder of the year.

Because all the female Canker Worms must crawl to the living twigs to deposit their eggs, it is possible to prevent this by putting bands of very loose cotton, rolled outward, or some sticky substance, or loose wool, around the trunks of the trees in February and March. After the young commence to eat the leaves, it is possible to spray with arsenical poison, such as Arsenate of Lead, two pounds in fifty gallons of water, and thoroughly destroy them as promptly as possible. The younger they are when sprayed the better the results.

Frog-Eye or Round Leaf-Spot: This is the name of a fungous disease of the leaves of apple trees, which appears to have come into this State during very recent years from the South, and is spreading northward with very destructive effects. The name of the disease is given from the fact that it produces round brown spots in the green leaves, which very much resemble the round ear drums or so-called "eye spots" seen on the sides of the frog's head just back of its eyes. Several of these spots may occur on one leaf and cause the leaves to fall prematurely and result in the produc-

tion of fruit of only poor grade, if any. As for other fungous diseases, these are easily prevented by spraying at the proper times with the Bordeaux Mixture. In an orchard where infection occurs the spraying should be done about once every two weeks during the summer, and also repeated after a hard rain washes the leaves.

Apple Leaf Miner: This comparatively new destructive insect in this state makes a mine or tunnel in the green tissue of the leaves between the two layers or coverings, and as several may occur within one leaf they have a destructive effect and results similar to those of the Frog-Eye fungus. The mines or tunnels made by this insect can easily be recognized by the fact that they are trumpet-shaped or worm-like in appearance. The larva which makes them transforms into a pupa and in the spring developes into a very minute moth which lays the egg on the leaf, and the larva hatches from this. Where this pest occurs the falling leaves should be gathered and burned as completely as possible. A spray of arsenate of lead and Bordeaux Mixture, kept on the leaves during the spring and the early summer to destroy the young larva at the time they hatch from the egg, and before they are concealed within the leaf, is the only practical remedy that can be offered at this time besides the destruction of infested foliage or fallen leaves to prevent its spread. It is urgently requested that readers should also watch for this insect and send reports and samples of infested leaves to this office. Special attention must be given to this pest in this State before it spreads further.

Railroad Maggot: This name is given to a white "worm" or maggot which is really the larva of a fly, and should consequently be called a maggot. It bores through the pulp of the apple, making its path in a winding manner through the fruit, and doing even greater damage than does the destructive Codling Moth. Its work is to be known at once by the small winding path made through the pulp of the fruit. It does not attack the seeds or core, as does the Codling Moth. It has comparatively recently come into this State, chiefly from the North and East, and it is very important for fruit growers to watch for it and report its occurrence to this office, in order that we can help to suppress it before it becomes more generally extended over the orchards of this Commonwealth. It may, in time, become by far our most important apple insect pest.

The egg is laid on the fruit by a gray fly, slightly larger than the House Fly, and the larva is about one-fourth the size of the common or average dressing pin. Its presence is readily recognized by its winding tunnel bored through the fruit. Where it occurs fallen fruit should be gathered promptly and completely and fed to pigs, or the hogs or sheep should be permitted to have free range of the

orchard. It is very important for the occurrence of this pest to be reported by observers to this office.

Oyster-shell Scale: The Oyster-shell Scale is generally a dark gray or brownish color, but not white, forming a perceptible ridge on the bark where it is fixed, two or three times longer than wide, and curved in the form of an oyster shell. From the central part of Pennsylvania southward there are two broods per year, the young appearing about the middle of May and again about the early part of August. The female lays her eggs beneath the old shell and dies, and the pearly white eggs remain unhatched under the shell during the winter. Their injury is done by injecting a poisonous saliva into the inner bark and sucking the sap therefrom, according to the habits of other species of scale insects and Plant Lice. Remedies are discussed in our Bulletin for last November.

The San Jose Scale: This little but terrible pest is about the size of the dot over the letter "i" in this Bulletin, and is perfectly circular, with a little point in the center. Often they occur in such numbers as to completely incrust the bark of the tree. They may fix upon any portion of the tree above ground, including the leaves or fruit. They often cause the inner bark, especially of pear trees, to become red by their poisoning, and cause little red specks on the growing shoots and fruits. They are to be killed by the methods advocated in previous numbers of this Volume.

The Scurfy Scale: This is one of the older scale insects on fruit and shade trees, given its common name from the fact that it resembles a flake of scurf or dandruff, such as is sometimes seen in the hair. The female is gray and fan-shaped, and about the size of the letter "v" used in this Bulletin. The male is quite small and narrow, being no larger than the body of the letter "i" in this print. Beneath the scale of the female are to be found the purple eggs during the winter time and about midsummer. There are two broods per year, the first hatching about the third week of May, and the second hatching during the early part of August. The life history, effects and remedies are practically the same as for the Oyster-shell Scale. Spray when the trees are dormant with such insecticides as are recommended for the San José Scale, or spray just after the eggs hatch with mild contract insecticides, such as are recommended for Aphids or Plant Lice.

The Tent Caterpillar. As common and conspicuous as this pest is it is often confused with other species of caterpillars or larvæ of moths. This name is given only to those hairy caterpillars which hatch from a band of eggs encircling the twigs of cherry, peach, wild cherry and a few other trees, and form tents of thick white sheets of webbing in the forks of the branches on the trees during

the months of May and June. The tents may remain in a more or less dilapidated condition during all the year, but the worms or caterpillars do not remain in them after the latter part of June. This term should not be given to the Webworms, which construct loose web coverings over the leaves of various fruit and forest trees later in the year, nor should it be given to the caterpillars that denude walnut trees and form bunches of cast skins on the trunks. Tent Caterpillars are to be killed by clipping off the egg masses during the winter and spring and by spraying with arsenical poisons as soon as they appear and commence to form their tents in the spring, and by removing their tents with a brush on the end of a pole or by shooting them out of a tree with a shotgun loaded with only powder and paper. If a torch be used for burning them out, it can be made effective, but is liable to injure the tree, unless one be careful to hold it near the brances only a very few seconds.

Apple Scab: This is a fungous disease which causes the scabby condition of fruit and leaf, and it is to be prevented by spraying with the Bordeaux Mixture in the same way and at the same time as for Frog Eye and other fungus diseases.

Woolly Aphis: This is a dark blue plant louse, which secretes a white waxy or woolly substance over its body that protects it from cold, heat and water, and also from its enemies. The white covering and the number of these insects together form what resembles a small tuft of wool, from which the common name is derived. They may live on the roots of trees, or on the trunk, branches or leaves. Where there are injured spots the Woolly Aphis is especially liable to be found, and by its continuous injection of a poisonous saliva and sucking the sap of the tree at such place, it causes a permanent injury and often results in the formation of knots or galls. When it occurs on the roots of trees the best remedy is to uncover the infested roots and put immediately over them a liberal sprinkling of finely ground tobacco leaves or tobacco dust and replace the soil. The Woolly Aphis above ground can be killed by painting or spraying the spots which it infests with strong soap solution, oil emulsions, strong tobacco decoction, lime-sulphur wash, Niagara Spray, or any other good contact insecticide.

APRICOT.

(See discussion of Peach and other stone fruits.)

ASPARAGUS.

Asparagus Beetles: There are two kinds of Asparagus Beetles, both of which injure the asparagus plants by eating the green parts and making holes in the stalks, and by laying their eggs upon the plants, from which eggs, grubs or larvæ hatch and feed upon the green parts of the plant. In habits, effects and remedies the two species are similar, but the beetles are distinct, the one known as the Common Asparagus Beetle being found much more extensively in this State.

The Common Asparagus Beetle is blue-black in color, with red thorax and lemon-yellow and dark blue wing covers, with a redish border. It is less than one-fourth inch in length. The less common species in this State is called the Twelve-spotted Asparagus Beetle, and may be distinguished by its color, which is orange red, with six black dots on each wing cover, making twelve black dots on the upper side of the orange red insect. It closely resembles the ripening asparagus berry. This species of insect has been introduced in to our State from the Southeast and it is gradually spreading northward and westward over the State. We should like to know its range, and ask for specimens and information concerning its occurrence in this Commonwealth. Both species deposit rows of small dark eggs, placed endwise on the plants. The remedies for both are the same, and consist in cutting low the entire patch of asparagus, destroying the food supply, or dusting with flour and pyrethrum, or permitting a portion of the patch to remain uncut and dusting it with flour and Paris Green when damp with dew, or spraying with some other arsenical poison, especially Arsenate of Lead, which will stick to the plants that are not to be used for food.

Asparagus Rust: This is a disease which occurs where the plants are too damp and the air circulation is poor. It is to be prevented by cutting all the plants low and frequently, and spraying with Bordeaux Mixture during the season after the cutting stops. Cut and burn the rusty plants in the fall as soon as they ripen or commence to die.

BEANS.

Anthracnose or Red Spot: This is the disease which causes dark or red cancer-like spots in the bean pods. The remedies are discussed in our May Bulletin.

Mildew: Mildew is a common plant disease, which may attack beans, carnations, roses, peas, violets and other plants, and is to be prevented by spraying with dilute Lime-sulfur Wash, with some extra free Sulfur added, or with Potassium Sulphide, or dusting with very fine Sulfur, when damp.

Weevil: The Bean Weevil is a small insect several of which sometimes feed inside one bean. The eggs are laid in the pods when the beans are growing, and the larvæ bore into the interior of the bean and feed during the fall and winter. To destroy them the beans should be fumigated with Carbon Bisulphide or Hydrocyanic Acid Gas as soon as they are gathered, and again before they are planted in the spring.

CABBAGE AND CAULIFLOWER.

Cabbage Worm: The common green Cabbage Worm reaches a length of about one inch, and appears to be covered with delicate green velvet. It eats the leaves of Cabbage and Cauliflower and proves very destructive. It is the larval or immature form of a white butterfly, of which two species are common. It is to be killed without any trouble by spraying with Paris Green in water, or, better, Arsenate of Lead in water, or by dusting the Cabbage with flour, twenty parts and Paris Green one part. If applied in a dust it should be while the plants are damp with dew. When applied to heads that are three-fourth or less grown, there is not the least danger in using poison, and there will be no trouble of loss by the worms.

Cabbage Plant Lice: These are the minute insects belonging to the large family of Aphids, which are at times seen covering the leaves, especially the under sides. Aphids or Plant Lice should be too familiar to every grower of plants to need description. When they are present on Cabbage they should be destroyed at once, by either picking off and burning the leaves they infest or by spraying with an up-turned nozzle, which will be sure to reach them on the under sides of the leaves, using ten per cent. Kerosene Emulsion, with some Resin or Whale Oil Soap to make it stick to the plants. Whale Oil Soap Solution alone, one pound in six gallons of water, will destroy them, as will also a strong solution or decoction of tobacco.

Caterpillars: Various kinds of caterpillars, or larvæ of moths, may be seen at times eating holes in the leaves of heads of Cabbage. These should be destroyed by spraying with arsenical poisons, such as Arsenate of Lead, or by dusting with Arsenites, or by

hand picking. It is our opinion that Cauliflower can not be sprayed with arsenical poisons with the certainty of safety that can be felt in spraying Cabbage. Therefore, we advise the use of an insect powder, such as pyrethrum or hellebore, instead of arsenites in treating Cauliflower.

Clubroot, Bigroot or Bigfoot: This is a disease of the stalk of the Cauliflower and Cabbage by which it swells to enormous size and stops the growth of the plant. The disease may be in the soil in which the plants are grown, or it may be in the soil in the field in which they are set, or it may be on the seed and infect the plant bed and later the soil in the field. The best preventive is to mix Lime and Sulfur, about ten parts of the former to one of the latter, and stir a handful of this into the soil at each place where a plant is to be set. Other remedies are discussed in our May Bulletin.

Harlequin Bug: This insect is a true bug, having a long suctorial bill. It is brightly colored or marked with red and black, and being in the form of a double triangle it is readily recognized. It is a southern insect, coming into this State from the South, and sucks and blights cabbage and similar plants, but does not gnaw them. It is to be found upon Cabbage, Cauliflower, Kale, Mustard and other cruciferous plants. We wish records of the occurrence of this insect in this State, and shall thank our readers to report it, in order that we can make charts of the area infested by it. To destroy it, either pick it by hand or sow a small trap crop of Mustard, and after the insects congregate upon the plants spray them with Kerosene.

The Root Maggot: This insect is the larva of a fly about the size of a House Fly. In the stage in which it infests the roots, it is a maggot reaching a length of slightly over one-fourth inch. It feeds upon the soft tissue surrounding the roots of Cabbage, Cauliflower, Radishes, Turnips and other cruciferous plants, probably also including Mustard and wild plants of the same family. It sometimes causes the plants to wilt down suddenly as though their roots had been cut off, or as though their leaves had been scalded. Upon examination of the roots of such plants, they are found to be stripped of their outer or fleshy layer. This pest is best prevented by putting a disk of tarred paper, about three inches in diameter, closely around each plant at the time it is set into the ground. Split the paper to the centre so that it can be put around the plant and firmly pressed down to the ground. Several remedies are mentioned on page forty-five of this volume. The tarred paper disks are best to prevent its entering the roots and the carbolic emulsion will kill it after entering. It is not so destructive on the late Cabbage plants, and consequently it is advisable to plant the bulk of the crop for home use for winter, for kraut, etc., at a late planting.

CARNATIONS.

Anthracnose or Rust Spot: This is a plant disease attacking the various parts of the plants in spots, causing death to the tissue, and in fact acting as a vegetable cancer. It is to be prevented by spraying abundantly with the Bordeaux Mixture or Cupram.

Mildew: (See Mildew on Bean.)

Red Spider: The Red Spider or Red Mite is an insect which is at times very destructive to plants. Those plants that are subject to Mildew are especially liable to be attacked by the Red Spider. It is a suctorial creature, and therefore can not be killed by internal poisons or arsenites. It is not always red, but may be white or greenish, and this common name, therefore, may at times be misleading. Where a strong jet of water can be had it is advisable to wash the infested plants by such means, knocking the pests from them. Also it is well to spray with almost any materials recommended for Mildew. Sulfur and its compounds are specifics against the Red Spider. The dilute Lime-sulfur Wash, made so dilute that it will not injure the foliage, and having some free Sulfur added, will give excellent results for Red Spider. A dust of Sulfur and Lime, or Sulfur and Flour will also be useful in suppressing this pest. Potassium Sulphide Solution with some Flowers of Sulfur added, is especially good, while results can also be obtained by the use of Whale Oil Soap or Kerosene Emulsion.

CHERRY.

Cherry Aphis: The Cherry Aphis is a plant louse, but instead of being green in color, as are those which have been previously discussed in this Bulletin, it is of a dark brown color. The Brown Aphis is also sometimes found on Peach. The plant lice of this color are more hardy or less easily killed than are the green aphids or plant lice. We have several records of their having been destroyed and the trees cleaned nicely by the use of the boiled Lime-sulfur Wash, applied in the spring while the buds were swelling. We recommend this for Cherry, Peach and Plum each year, whether the San josé Scale be present or not. Also, a strong solution of Whale Oil Soap, one pound in five gallons of water, strong Tobacco Decoction, or 12 per cent. Kerosene Emulsion, applied as a spray, will kill them.

Black Knot: The Black Knot is one of the important plant diseases in this State against which there is legislation, and for which the

law should be strictly enforced. It is to be recognized as a hard rough black fungous growth, causing deformity of the branches, seen on the twigs and branches of plum and cherry trees as black knots of varying sizes and shapes. The only known remedy is to cut it out and burn it, sterlizing the knife occasionally by dipping it into turpentine, Bordeaux or Lime-sulfur wash, and washing the freshly cut surface of the branch with paint, turpentine, Bordeaux Mixture, or some other sterlizing material. There is no spray that will cure Black Knot, but spraying with Lime-sulfur Wash or Bordeaux Mixture will greatly aid in preventing its spread. It should be cut and burned promptly wherever seen.

Cherry Curculio: The Cherry or Plum Curculio makes "wormy" cherries. The damage is done in the larval or grub stage, from which it enters the ground, transforms to the pupa, and remains over winter to come out in the spring in the form of a snout Beetle. The trees should be sprayed with Arsenate of Lead and Bordeaux mixture, using two or three pounds of Arsenate of Lead in fifty gallons of Bordeaux just after the buds burst, but before the blossoms open, and again with the same liquid soon after the petals or flowers fall, and this spray should be repeated again in a week or ten days. It is advisable to cultivate the ground about the middle of July under infested trees and permit fowls to run in the orchard or yard where cherries and plums grow. Pick off the fruit that indicates that it is stung or infested, and feed to the poultry or pigs and have fowls ready to destroy the fruit which falls early because infested with "worms."

Cherry Fly: A new cherry pest, the adult is a spotted-winged fly, and the larva is a maggot in the fruit. Remedies, as for Curculio.

Rot: The Brown Rot or Monilia of Cherry is a disease which infects stone fruits, such as Cherry, Peach and Plum. Next to the Curculio causing wormy fruit, rot is liable to be the worst enemy of the cherry fruit. It is sometimes called the Ripe Rot, because it comes almost suddenly about the time the fruit is commencing to ripen. It can be prevented by faithfully spraying with the Bordeaux Mixture, as described for the Curculio, but keeping up the spraying about once every two weeks during the growing season, and repeating this when the leaves and fruit are washed clean by a hard rain. After the fruit is full grown and commences to show color of ripening it should be sprayed with Cupram solution, which is a colorless fungicide and will leave no stain. Rotten fruits of Peach, Plum and Cherry should never be permitted to remain on the trees nor left on the ground, but should be gathered and burned to prevent the spread of the millions of rot germs that can be seen as a white powdery covering on the surface of such fruits.

The Leaf Slug: The Cherry Leaf Slug is one of the slug-like insects resembling a shell-less snail, which lives on the leaf by devouring the epidermis and causing the leaves to appear brown or scorched. It is a moist, dark, almost shapeless mass, and is one of the most easily destroyed insects that infest the foliage of fruit trees. Similar larvæ destroy the leaves of Plum and Pear trees, and are to be killed by dusting with Paris Green with freshly slacked Lime. One part of Paris Green should be added to twenty parts of Lime, or spray with any of the arsenical poisons or dust with Hellebore. Any of the spray liquids for killing leaf-eating insects, such as caterpillars, will destroy these Slugs, and because their bodies are slimy and moist they are killed by the Lime dust, the same as are the larvæ of the Asparagus Beetles.

CORN.

Corn Worm or Boll Worm: This is the larva of a grey moth over one inch across the wings, which is found feeding on the grains of soft (green) corn beneath the husks, and also in bolls of cotton and sometimes in ripe tomatoes. It is a striped larva, reaching a length of over one inch, and is sometimes common in the ears of sweet corn. It should be destroyed by picking by hand; and wherever ears of corn show signs of infestation, the husks should be opened and the larva destroyed. Also, plow late in the fall to kill them while they are hibernating.

Corn Root Worm: This is a larva which feeds on the roots of young corn in the spring of the year, and consequently does considerable damage. It must not be mistaken for the cutworm, as it works at the roots themselves, and does not cut off the stalk. Also, where this pest is found growers should practice rotation of crops, and avoid frequent planting of corn in the same ground. This is the best means of overcoming this pest.

Cutworms: These insects are the young or larvæ of dark gray, common moths, such as fly at night, and are often called "millers." In their larval stage they feed chiefly on the roots of vegetation beneath the surface of the ground, and generally remain concealed during the day time, feeding mostly at night. They come from eggs that were laid by the moths, generally near the roots of grasses, and when a sod field is plowed they remain in the soil ready to attack whatever crop follows. They are thus sometimes forced to appear in numbers as enemies of the young corn plants. They cut off the plants beneath the surface of the ground and eat the tissue, but do not seem to draw it down into the holes in the ground as does the

Earthworm. They are best prevented by practicing such rotation of crops as to prevent planting corn upon grass sod, and especially upon a sod of long standing. Where it is necessary to plant corn on sod, the ground should be plowed in the fall and cultivated as late as possible and again cultivated in the spring as early as possible. It should be allowed to lie fallow until late spring and planted late. This is to kill the Cutworms or starve them out. In addition to this, poison bait should be used, made with Paris Green and sweetened bran, and dropped occasionally over the ground they inhabit. After the corn has sprouted in the spring and the Cutworms commence to destroy it, these pests can be killed by poison baits dropped over the ground in the evening when it is damp, or placed under boards. Also after a rain they can be found by going over the fields and watching for places where they have freshly broken the soil, like miniature moles, and pick them by hand and destroy them.

Smut of Corn: These are the large black balls that form on various parts of the stalk, leaves and tassel. Such masses should be gathered and burned before they become dry. Do not destroy them by throwing them on the manure heap nor permit them to remain on the ground.

Root Lice and Ants: The small holes freshly made beside the stalks of young corn growing in rows are often quite conspicuous, and indicate the presence of Ants at the roots. The stalks may be feeble and indeed much impaired by the injuries caused, not by the Ants, but by Root Lice which the Ants protect and which in turn suck the sap from the corn plants and often injure them materially. To prevent Ants and Root Lice, practice rotation of crops, plow in the fall, cultivate late in the fall and again early in the spring, keep down all weeds, and cultivate frequently. Plant the corn with fertilizer and thus stimulate its growth at a time in its life when it is most likely to be enfeebled by numerous small pests.

Web worms: These are the small larvæ or so-called "worms" that are often seen in many young stalks of corn. They bore through the leaves before they are unfolded and feed in the heart of the stalk. They thus do a great deal of damage because they injure it while it is young. They spin silken webs over themselves and thus find protection. There is no known remedy for them after the corn is planted. Fall plowing and cultivation, as for Cutworms and Root Lice, is recommended. Rotation of crops, and avoidance of planting corn on sod infested with these pests are especially advisable. Stimulate by commercial fertilizer and cultivate thoroly.

Wire worms: The insect that is properly called the Wire worm is a somewhat hard-shelled beetle larva, which is the young or immature stage of the Click Beetle or Snap Beetle, or "Snapping Bug." The eggs are generally laid in sod, and the young Wire worms live

there, but when the sod is turned down the larvæ continue to feed on the plant tissues in the soil. There is practically no remedy for them after they once commence their depredations on the growing corn in the spring. It is said that they can be poisoned by dropping slices of potatoes, poisoned with Paris Green and flour, on the ground in the evening when it is damp, and putting such poison bait beneath boards. The poison bran is also to be recommended. To avoid them it is best to rotate crops, so the corn does not follow grass, plow late in the fall, and otherwise treat the ground as for Cutworms, Root Lice and Webworms.

CUCUMBER, MELON AND SQUASH

Downy Mildew: Downey Mildew is a disease that causes these plants to look as though sprinkled with flour or covered with a light or downy substance. To prevent this, spray them with the Bordeaux Mixture, and gather and burn the vines as soon as the desirable portion of the crop is gathered.

Blight: Melon Blight is the name of a disease which causes the leaves to turn black or brown and may destroy the entire crop. The best treatment is abundant and thorough spraying with Bordeaux Mixture. In growing melons where this is liable to occur, they should be planted with a view of driving the spraying apparatus between some of the rows for the purpose of spraying them. The grower can use either a field crop sprayer or barrel sprayer with long hose. We have had occasion to see the good results of spraying with Bordeaux Mixture for Melon Blight.

Borers: The Borers of squash, pumpkin and similar vines are white larvæ, which are the young of moths, which fly by day and look much like wasps. They are called clear-wings and are not easily caught or trapped. Unlike most moths they become dormant or inactive toward evening and remain so in the morning. These mature or winged insects at such times, and also when the weather is rainy, cling to the under sides of the leaves, and there may be found and killed by hand. They lay their eggs on the vines or large stalks, and into these the Borers eat their way, and there they remain and feed until they are mature. They can be killed by puncturing them with a sharp pointed wire inserted into the stalks and pushed along in the hollow until the larvæ are pierced, or they can be killed by slitting the vines lengthwise to reach them. The cutting should be done lengthwise instead of crosswise. The vines should be covered at intervals to permit them to take root at several places, and they will then thrive even though they should be

cut off near the original hill or root. The borers can be killed at the times the eggs hatch and the young larvæ commence to feed, if the vines are at that time dusted with Paris Green and flour, one part of the former to twenty of the latter, or by spraying with arsenical poison.

Squash Bugs: The Squash Bug is a long brown stinking bug that is often found on the squash, cucumbers and similar vines. They are too well known to need further description. They lay a number of large reddish brown eggs, about one-eighth of an inch apart, and from these hatch small active bugs with long legs and antennæ, which live in colonies and suck the juices from the leaves and also poison them by injecting poisonous saliva, causing the leaves to turn dark and wither at the infested spots, looking very much as though scalded with hot water. Since they are not chewing insects, they cannot be killed with arsenical poisons, but hand picking, contact sprays, traps and other means of destruction must be used.

Striped Cucumber Beetles: These are small, yellow and black striped beetles, about one-fourth of an inch in length, that are to be seen in the spring on the leaves of cucumbers, melons and similar vining plants. The beetles eat holes in the seedling leaves and other leaves as fast as they appear, and in fact may destroy the entire young plants. They lay their eggs in the ground very near the plants they infest, and their larvæ feed on the roots of the plants, eating away the outer soft tissue and causing the plants to wilt almost suddenly as though they had been frozen or the stalks had been cut off. To prevent injury by this insect cover the plants with nets until they are well started, or dust them with Paris Green dilute with flour or with air-slacked lime scented with terpentine over which place mosquito netting.

For the larvæ around the roots use tobacco dust in abundance. Not only will it destroy the pests, but it will be a good fertilizer for the plants.

CURRANTS.

Currant Fruit Worm: This is the name of the insect which lives as the larva inside the currant berry and is properly called the currant Maggot. It is the larva of a fly and is difficult to destroy, owing to the impossibility of reaching it with either contact insecticides or poisons. Prematurely ripening fruit should be picked and fed to the fowls or pigs, and all infested fruit should be gathered on the bushes or on the ground and destroyed or crushed under foot. The fallen leaves should be raked together and burned, and the

plants should be sprayed with arsenical poisons, such as Arsenate of Lead and Bordeaux Mixture, soon after the blossoms fall, and repeated two or three times at intervals of about two weeks. Of course, the fruit should not be used while a trace of the arsenical spray remains, and it should not be applied after the fruit is more than half grown.

The Currant Worm: This is the name of the green and black spreckled larva that is often seen eating the leaves of currant bushes and reducing them to mere ribs. It is the larva of a wasp-like insect called a Sawfly. The white eggs are laid in rows on the under sides of the veins or ribs of the leaves. After they feed and become full grown larvæ they enter the soil where they spin cocoons and remain during the winter, to come forth the next spring in the winged state. They are easily destroyed by dusting with Hellebore or applying a spray of Hellebore stirred in water, one spoonful to a gallon of water is sufficient. A good dusting material is made by mixing one pint of Hellebore with four or five parts of flour and keeping it in a closed vessel for a few days or longer. The Currant Worms are also killed by spraying with arsenical sprays, like Paris Green or Arsenate of Lead, and with contact insecticides such as Whale Oil Soap, Kerosene Emulsion or freshly slacked lime.

ELM.

Elm Leaf Beetle: The adult form of this beetle is a dark-colored, small, hard shelled insect, not more than one-fourth inch in length, which is to be found in the early spring in the grass or soil around the base of elm trees, and which lays its eggs on the elm leaves. The larvæ feed on the leaves, eating holes through them, and make them appear quite netted. They effect a great deal of injury by the defoliation of the trees. Fortunately, they do not occur in many portions of this State, but we should be glad to have specimens and reports of their occurrence from the parts which they now inhabit. Infested trees should be sprayed with Arsenate of Lead or Arsenite of Lime as soon as the first leaves appear and sprayed again and repeated as often as any of the pests are found present upon them.

The Tussock Moth: This is a common enemy of many shade and fruit trees. In the larval stage it is easily recognized as one of the most familiar hairy caterpillars. It has long tufts of black hairs like pencil points, projecting from it and shorter knobs of red and white hairs arranged along its back. It feeds on the leaves of most kinds of shade trees, and is especially injurious to trees along village and city streets. It is the chief enemy of the trees in the streets

and parks of Philadelphia. When it becomes grown it attaches itself to the bark of the trunk or larger branches and spins a loose cocoon, using also the larval hairs for this purpose. Within this a chrysalis forms, and later the moth appears with vestigial and useless wings. She cannot fly, and remains on the old cocoon where she lays white eggs and covers them with a frothy substance which becomes dry and hard. It is not difficult to gather and destroy these egg masses on the old cocoons as they are seen upon the branches and trunks of the trees. Doing this in the spring, or touching them with sponges dipped in a soap or oil solution will be effective. A saturated sponge may be attached to the end of a pole and dipped in Kerosene or Crude Petroleum, and they can be touched in this way. When the larvæ are present spray with arsenites to poison them on the leaves in midsummer. The egg masses of the second brood should be destroyed by hand.

GOOSEBERRY.

The Four-lined Leaf Bug: This is a bug or suctorial insect belonging to the suborder Heteroptera, which destroys the leaves by puncturing them with its poisonous bill, causing them to turn dark and die. It is to be recognized by the four stripes running lengthwise on its body. From these it takes its name. It can be killed by spraying with Kerosene Emulsion or Whale Oil Soap.

Gooseberry Fruit Worm: (See Currant Fruit Worm).

Leaf Blight: This is a disease of the leaves, causing them to turn dark and die or sometimes become deformed. Spray with the Bordeaux Mixture, shortly after the blossoms fall, and with Cupram after the fruit becomes larger, and with either fungicide after the fruit is gathered.

The Stem Borer or Girdler: This is the insect which bores in the stems of currants and gooseberries, sometimes causing the leaves to turn yellow and thus indicating their appearance. The stem that is infested dies, and should be cut out as soon as the yellow leaves indicate its condition, or as soon as it can be found and burned while the pests yet inhabit it, in order to destroy them before they escape.

GRAPE.

Anthracnose or Bird's-Eye Rot: This is a Brown Rot, or what might be called Cancer, that appears on the fruit in the form of round spots somewhat resembling the eye of a bird,—hence the

second common name. The proper treatment is to spray or wash the vines, posts and trellises with Sulphate of Iron and Sulfuric Acid, or Copper Sulphate, in water, one pound in ten gallons of water, while the vines are dormant, preferably before the buds open in the spring and repeat this three or four days later, but do not apply it so strong after the buds burst or the leaves appear. Spray occasionally with the Bordeaux Mixture after the blossoms drop.

Black Rot: This is a disease of grapes that causes the fruit to turn black, decay, shrivel and remain on the vines. It is easy to prevent it by spraying with the Bordeaux Mixture about the time the buds are bursting, and repeating this once every two weeks until after the fruit is half grown. Avoid spraying while the vines are in bloom. After the fruit is half grown use Copper Carbonate and Ammonia, which is the Cupram solution, repeating this every week or two if any signs of rot are to be seen. It is also advisable to pick off and burn all rotting grapes as soon as they are seen, and especially avoid leaving bunches hanging on the vines when rot is in them.

Downy Mildew: This is a disease making the leaves look as though dusted with a substance like fine down. Sulfur or Sulfur Compounds are specifics. (See Downy Mildew of Cucumber.)

Grape Vine Leaf Hopper: This is a small insect not one-fourth inch in length, belonging to the suborder Homoptera of the order Hemiptera, or True Bugs, discussed in a previous Bulletin. It has a piercing and suctorial mouth, and consequently does not eat away the tissue of the plant, but sucks the juices and injects a poison. Owing to their immense numbers they cause considerable damage. The eggs are laid on the under sides of the leaves. The young there hatch and first look like small plant lice, but are active and run quickly. The white cast skins remain clinging in numbers to the under sides of the leaves. When young they do not have wings. and consequently do not fly, and can not escape the insecticides applied as sprays. When full grown they are winged and jump and fly quickly and may escape the spray. The same remedies are to be used for these that are recommended for plant lice. For the winged or mature insects, it is a good plan to spray with five per cent. Kerosene Emulsion, which will force them to go to the ground, where they try to rub the liquid off their wings. Then immediately spray again with either a fifteen per cent. Kerosene Emulsion or Mixture or with Whale Oil Soap, one pound in four gallons of water, or some other strong soap solution. While these stronger sprays would be liable to injure the leaves of the grape vines, they can be applied to the insects on the ground without danger to the plants and with certainty of killing the pests.

For spraying the young insects, up-turned nozzles should be used, and care should be taken to reach them on the under sides of the leaves. As they are entirely suctorial in their feeding, poisons are of no use against them.

Powdery Mildew: This is another Mildew disease which appears as fine white grains rather than as small threads and more closely resembles flour dust. The treatment is the same as for the Downy Mildew.

Grape Root Worm: This insect takes its name from the fact that it feeds on the roots of grapes in its larval stage and is very destructive in that form and situation. In its adult stage it is a dark beetle called the "Steely Bug," which is probably so called from the metallic lustre of its wings.

It passes the winter in the ground, and comes forth as an adult beetle in the spring, feeding on the leaves for a short time before laying its eggs, from which hatch the larvæ or worms that feed on the roots. Watching for the adult beetles in the spring and as soon as they appear spraying with the Bordeaux Mixture and Arsenate of Lead, using about two or three pounds of the latter to fifty gallons of the former, is recommended. Where there are but very few vines, hand picking or jarring while it is quite cold in the morning is advisable. After the worm starts to feed on the roots of the vines it can be killed by injecting Carbon Bisulphide into the soil around them. Make holes six or eight inches in depth and two or three feet apart and pour from one-fourth to one-half teaspoonful of Carbon Bisulphide into each hole and close it with earth. Cultivate the soil frequently, especially just after the larvæ transform into pupæ or go into the resting stage.

Grape-vine Flea Beetle: This is a small beetle of dark color, not much larger than a common house fly, which jumps like a flea and is given this common name in consequence. It is not so easily killed as the Grape-vine Leaf Hopper, because it is a beetle or hard-shelled insect, and is less readily affected by contact sprays. However, it is a sucking insect and can be killed with arsenical poisons. It is partially prevented or repelled by the use of Bordeaux Mixture alone, and this spray can consequently be used at a time when the fruit is so far developed that poisons would not be advisable. However, at other times it would be best to add Arsenate of Lead, two or three pounds to fifty gallons of the Bordeaux Mixture.

The Rose Bug: This common and familar insect attacks a great many cultivated plants, trees and bushes by devouring the foliage when in the adult stage. It is not a bug but a beetle, as it has chewing mouth parts and eats the tissue of the leaves, making them appear to be perforated with numerous holes with quite irregular

edges. The larvæ of this bettle live in the ground and there transform to the pupal or resting stage and remain over winter. Deep cultivation of the soil near the roots of rose bushes and other plants they infest is advisable. Growers should watch for the first coming of these beetles in the spring, and jar them from the vine on sheets saturated with oil on the ground or held to catch the pests, or into a hopper cloth bug catcher, or should pick them by hand, or shake them from the vines and spray them with pure Kerosene or exceedingly strong soap solution while they are on the ground, where the leaves and plants will not be injured by the strong spray. Where a person is growing but a few grapes it is advisable to cover them with paper bags as soon as possible after blooming and setting of the fruit.

HOUSE PLANTS.

Aphids or Plant Lice: These are similar in appearance to the Aphids and Plant Lice described under "Apple," and the same remedies are to be recommended, with the additional directions to destroy them by holding the infested plants for a few seconds in the steam from a kettle, at such distance from the mouth of the spout as would be the extreme heat that can be borne by the hand held in it for the same length of time, or they can be destroyed by immersing the plants in hot water as hot as the hand can possibly bear for the same length of time.

Earth Worms: It is not generally known that Earth Worms or Angle Worms sometimes called "Night Crawlers" are injurious to the roots of vegetation by eating them, and even to young and tender garden plants and others by cutting them off at night and drawing them down into the holes. The work of the Earth Worm differs from that of the Cutworm in the fact that the former makes a long deep hole and during the day time retreats to the depth of the same and in feeding at night will often pull young plants and drag them into the holes if possible. We have actually seen onion sets in gardens pulled from the soil by Earth Worms. Their presence is indicated by the small pellets of finely ground worm-shaped castings of earth arranged in little mounds over their holes. To destroy them soak the ground abundantly with a very strong solution of lime water or with a weak solution of salt water.

Mealy Bugs: These are small pinkish to whitish insects which in appearance and habits may be said to be midway between Plant Lice and Scale Insects. They are partially covered and protected by a mealy or waxy secretion. They are especially bad on Coleus

plants and some other kinds. The treatment is the same as for Plant Lice, with the additional recommendation to touch them with a fine brush dipped into pure Kerosene.

Nematodes or Root Worms: These are not insects but very small white worms averaging smaller than a very small sewing needle. For potted plants, avoid fresh sod but use well rotted older earth for the purpose. Before using it, heat it three hours in an oven, or disinfect it by steaming. When the pests are present inject Carbon Bisulphide into the soil around the plants, or remove the plants from the infested soil, wash the roots in warm water, and replant in clean soil.

HOUSEHOLD PESTS.

Ants: These are too well known to demand description. Ants of three or four different species may cause trouble in the household. The best possible remedy is to trace them by the path in which they travel and find and destroy the nest. When the queen is killed the Ants will disappear. Do this by pouring into the nest a sufficient amount of Gasoline, Benzine or Kerosene. Be sure to reach the queen, or make a hole in the nest or as near it as possible with a sharp stick and pour in Carbon Bisulphide, and cover with a damp blanket to hold down the fumes. Methods of repelling Ants are discussed on page 48 of this Volume.

Bedbugs: These oval, flat, dark brown, foul-smelling and very offensive pests are too well known to need description. They often cause great annoyance, even in the bed rooms of the most thrifty and careful housekeepers. It is not at all necessary to suffer from the presence of such pests. There is nothing that is more easily, surely and effectively treated than pests in the rooms of houses. Fumigation with Hydrocyanic Acid Gas will do the work in a satisfactory manner. For each one hundred cubic feet of space one ounce of the Potassium Cyanide, two ounces of Sulfuric Acid and four ounces of water should be used. Before attempting to fumigate, the subject should be carefully studied, as the gas is a deadly poison to all animal life and human beings, and should not be used ignorantly. Write to this office for further information and for special Bulletin articles for which space in this particular Bulletin cannot be given. If for any reason fumingation is impractical, dissolve Corrosive Sublimate or Bicholoride of Mercury in alcohol and wash with this all places in which these undesirable pests can find concealment. Cracks of floors and walls and particularly their

hiding places in the beds should be thus treated. Do not keep this solution in metal or let it touch metal that is not to be corroded.

Buffalo Moth or Carpet Beetle: This insect in its larval stage is called the Buffalo Moth, perhaps because of the hairy and humped nature of the larva. It transforms into a pupa and from that stage into a small rounded, dark and slightly mottled beetle, about the size of a large radish seed. They are just small enough to be able to squeeze through the meshes of ordinary wire window screening. The damage is done in the larval stage, as these pests feed upon the wool or piling of carpets, making bare paths or spots. They are most destructive in spots where the carpet is less used, especially under furniture. They are to be killed by placing a damp towel on the carpet and ironing it with a hot flat iron to drive the steam down through the carpet, thus scalding them. Also, the edges of carpets and mats should be washed with Corrosive Sublimate dissolved in alcohol, and the carpets under furniture should be sprayed with an atomizer or small sprayer, applying this solution. Carpets and rugs should be frequently taken into the sunshine and open air and beaten vigorously. These pests can be killed by fumigation, as for Bedbugs and other household pests.

Clothes Moth: This is the insect which in its larval state makes a little tube from fibers of the material on which it feeds, and in which it finds concealment and protection. It destroys clothing or other articles made of animal material, such as wool, hair, feathers, fur, etc. It is inactive during the winter time in cold houses, but in houses heated by furnaces it may remain active and destructive all year. It transforms to a pupa within the case occupied by the larva, and from this comes the small winged moth which is light in color and has an expanse of wings of but little over one-fourth inch.

Methods of destroying or preventing them are fully discussed on page 48 of this Volume.

Fleas: These wingless but active, jumping insects are too well known to demand description. They do not originate independently as no insects generate in this manner. The adult or mature flea lays eggs, generally dropping them at night from the animals they infest, chiefly in the sleeping places of dogs and cats. We have seen great quantities of eggs of Fleas collected by placing a black cloth in the sleeping box of a house cat. From these minute white eggs hatch small larvæ, white in color, and resembling very small slender pointed wires. These feed upon organic substance in the cracks of floors and other places, transform there to pupæ, and further change to adult Fleas. This outline of the life history shows the reasons for advocating the eight different means of treatment for Fleas discussed on page 49 of this Volume.

Flies: These insects in the adult or winged state are well known, but their life history should be given. The House Fly is a type. The egg is laid in filth, mostly in or near stables. Within a few days the larva or maggot hatches therefrom and feeds upon the filth and grows until it reaches its full size, when it transforms into a brown pupa and remains inactive until it again changes to a winged insect. From this place of filth it flies and sooner or later reaches the household, where it not only causes great annoyance but often may introduce disease germs leading to serious results. With this knowledge a person can see the reason for advocating treatment given on page 49 of this Volume, including thorough and frequent cleaning of stables and such places, properly screening windows and doors, using sticky or poisoned fly papers, dusting with insect powder, and fumigating the rooms.

The Larder Beetle: This insect in its adult stage is fairly well known by persons who use dry preserved meat. It is a dark and gray mottled beetle, elongate oval in shape, and about three-eighths inch in length. It feeds on the meat and there lays its eggs, from which hatch larvæ that are covered with spiny hairs and may reach a length of nearly one-half inch before completing their growth and transforming into the pupæ. The larvæ are wrongly called "moths." The meat should be well brushed with a stiff brush to get rid of the pests in their various stages, and then enclosed in paper bags and tightly tied.

Mosquitoes: These common and troublesome pests also need no description in the stage in which we usually see them. Their life history, however, should be known in order properly to avoid them. The adult Mosquito lays its eggs in little rafts, which look like masses of soot, on quiet water. From these hatch the larvæ which are called "wrigglers" or "wriggle-tails," and live in water on the organic material there found. An ordinary rain water barrel will sustain enough wigglers to develop into Mosquitoes to give annoyance in several squares of a borough or village. An old vessel, such as a discarded tomato can, will support them in numbers. Care should be taken to avoid letting even small vessels of water stand open during the summer. In ponds or other places where the standing water is unavoidable the larvæ can be killed by putting oil of any kind on the surface of the water. Common lamp oil is effective. The remedies are discussed in the May Bulletin.

Roaches: Roach Bugs or Cock Roaches are the common, flat, reddish-brown, oval insects that are often seen in offices, pantries and kitchens, especially where much paste or flour is used. One species, which is most troublesome, is called the Croton Bug. They are sometimes destructive in libraries where they do damage by eating the glue from books or eating paper, card board or bindings

that have been glazed with paste or glue. They may also loosen wall paper by eating the paste from beneath it. They can be killed by placing a mixture of Plaster of Paris and powdered Sugar where they can eat it, or dusting abundantly with powdered borax, or spraying the cracks and places where they infest with the alcoholic solution of Corrosive Sublimate.

LAWN INSECTS.

Ants: See remedies for Ants under "Household Pests."

White Grubs: These are the larvæ of such insects as the May Beetles or June Bugs, the Bumble Flower Beetles, and some other beetles. They are commonly called Grub Worms. They may be quite destructive to the roots of vegetation planted where there is much organic material in the soil. They are worse where the old sod is turned down or where comparatively fresh manure has been used in abundance. The beetles lay their eggs in such places and the grubs there hatch, feed and grow. They may prove destructive to the roots or tubers of plants growing in the soil. We have observed the sudden wilting of melon vines in hills where manure was used, and have found this due to White Grubs eating off the roots. They may attack potatoes, corn and other plants, and sometimes are so destructive in grass roots as to destroy all the grass plants and leave spots brown and bare. They can be destroyed by injecting Carbon Bisulphide into the soil, as for the Grape Root Worm; also, let pigs root and eat them.

Cutworms: Described and discussed under "Corn" pests.

LIVESTOCK PESTS.

These are too well known to need description and the remedies are discussed on page 50 of this volume.

Bots: However, it should be more generally known that a disease known as Bots of horses is due to the larvæ of Flies of large size, which fix in the lining of the stomach, and may become so abundant and painful as to lead to fatal results. The Bot Fly lays its eggs on the hairs of the front legs, chest and neck of the horses, and these eggs remain as yellowish nits that are easily seen. The horses bite off and swallow the eggs, from which the larvæ hatch and live in the stomach and later are dropped on the stable floor. They transform into pupæ in the stable cleanings, and later change into the winged Bot Flies. This shows why the hairs containing the nits or eggs should be clipped from the horses whenever they are seen.

Bots in the head of a sheep, causing the so-called "blind staggers," are the larvæ of flies laid in the nostrils and developed within the head. This explains why the sheep should be salted in a trough in which the inner sides of the boards are smeared with tar, in order to prevent the Bot Flies from laying their eggs in the nostrils, which will become more or less covered with the tar from the trough.

PEA.

The Pea Louse or Aphis: This is a plant louse so closely resembling other Aphids or Plant Lice that the general descriptions given for the same group infesting Apple will enable pea growers to recognize this insect, as indicated by the name "Pea Louse." Remedies are given on page 51 of this volume.

Caterpillars or Leaf-eating Insects: Whatever species of insect may be found eating the leaves of plants can be destroyed by spraying with arsenites, such as Arsenate of Lead. This is to be preferred, because it can be used in greater and consequently stronger quantity without injury to the foliage, and also because it sticks better to the leaves than does Paris Green. Paris Green is next in order of material to recommend.

Mildew: Mildew is a well known disease of peas, and is discussed under "Mildew" of Beans.

Weevil: The Pea Weevil in its adult stage is a beetle somewhat resembling the Bean Weevil, but differing chiefly in size. Of course, there are other differences, one of which is that only one Pea Weevil is found in each pea, while several of the Bean Weevils may inhabit each seed. They excavate the interior of the Peas and make the round holes so familiar in these seeds. They should be killed either by fumigation, or by heating the peas to 150 deg. Fahr., for ten minutes after gathering, and also before planting, or by soaking the peas one-half hour in water as hot as the hand can be dipped into.

PEACH, PRUNE AND NECTARINE.

Borer of Peach: This destructive insect does its work entirely in the larval state, and is chiefly seen in that stage. It is then recognized as a white "grub" worm or larvæ living beneath the bark of peach, plum, prune and nectarine, and properly called "The Peach Tree Borer." It generally feeds beneath the surface of the ground, causing great masses of gum to form around the base of the infested

tree. Gum will form from other causes, but the presence of the Borer can be recognized by small brown objects like brown grains of sawdust in the gum which comes from its holes. It comes from an egg which is laid at the base of the tree by a clear-winged moth during July or August, and which commences to eat at the outside of the bark and soon cuts its way to the interior where it grows and remains as a larva during the winter and spring. About the first of June it transforms to a pupa within that a cocoon is covered with grains of sand or small particles of earth, and consequently looks like an oblong lump of earth, about an inch in length. From the latter part of June and later the beautiful, brightly colored. quick-flying, winged moths emerge from these cocoons. In flying by day and in quick, rapid, darting flight they resemble large wasps more than moths. Treatment is discussed on page 52.

Black Peach Aphis: Similar to the Aphis of Cherry previously discussed.

Brown Rot: The Brown Rot or Ripe Rot of peach and plum is a disease that causes the fruit to rot and turn brown about the time it is commencing to ripen. It is often designated in literature as Monilia. The fruit thus infected often remains on the trees, shrivels and becomes the "mummies" that are so frequently seen on peach and plum trees in the fall, winter and spring. The rot germs are spores which are to be seen in immense numbers as a white powder on the decaying fruit, and which can be blown from the fruit, looking like puffs of dust. It is very important to destroy all remains from the orchard of decayed fruit as soon as possible and spray with fungicides to prevent rotting. Recent experiments show that the best insecticide for the Brown Rot is either the Lime-sulphur Wash, made by putting Flowers of Sulphur on unslaked Lime and slaking the Lime by boiling with fire, using almost the same formula as for the San José Scale, but diluting with more water, to avoid injury to the leaves, or use a good commercial Lime-sulphur Wash, such as is made by the Niagara Spray Co., Middleport, N. Y., and called the "Niagara Spray." Dilute it two or three times the strength recommended for the San José Scale, with a few pounds of free or undissolved Flowers of Sulphur added. One of the best means of preventing Brown Rot is to avoid planting the early varieties, which are more susceptible to Rot, and keep the trees well pruned, in order to avoid much shade and dampness.

Curculio: See discussion under "Plum."

Little Peaches: This is the name of a disease which appears to have originated in some of the Northern States, perhaps Michigan, and is gradually becoming more extended over the peach growing portions of America. From one or two places it has been definitely reported in Pennsylvania, and also from some of the States south-

ward. The nature of the disease is not well known, but it results in the peaches remaining small and hard and not becoming fit for fruit. It is recommended to prune and burn the trees infected with this peculiar condition. We should like to have reports and specimens from trees supposed to be infected. It is essential to locate such diseases as rapidly as they appear in this State.

Shot-hole Borers: This is the insect that causes very small holes of uniform size about the size of a No. 6 grain of shot, often very close together in the bark of the trunks and branches of nearly all kinds of fruit trees and many shade and forest trees. Of course, the name is given from the fact that the hole made by the beetle in escaping from the place where it lived and fed as a larva, beneath the bark, looks very much like a puncture from a charge of shot from a shotgun. The holes from these beetles are seen only in trees that are dead or dying, and it is evident that they attack trees only when their condition runs low and they are ready to die. However, the Shot-hole Borer hastens their death and in some cases may attack certain branches while others may not be injured at the time. There is no known remedy after these pests have entered the trees. but when evidence of their presence is to be seen infested branches or trees should be cut and burned to prevent the spread of the pests to other trees. Severe pruning, spraying with the boiled Lime-sulphur Wash, fertilizing and cultivating, to increase the vitality of the tree will do a great deal to help in preventing loss by such pests.

Peach Leaf Curl: This is a fungous disease of the leaves, which makes itself manifest by causing them to become red and swollen, looking as though they had been blistered and stained red at the diseased part. The leaf becomes deformed and unnatural in appearance and, of course, is not able to perform its proper function in supporting the tree. Where Leaf Curl is abundant the fruit crop may be lost and further damage may follow by reduced vitality and failure to set strong fruit buds for the crop of the next year, as noticed by increased insect pests which are always ready to attack trees of lessened vigor. The Peach Leaf Curl is one of the easiest diseases to prevent. Spray with either the home-made boiled Lime-sulphur Wash or with a good commercial Lime-sulphur Wash, like the Niagara Spray, before the buds burst and at the same time that the spraying should be done with the same material for San José Scale and other pests. After blossoms fall spray with Bordeaux made with three pounds of Bluestone and five pounds of Lime in fifty gallons of water. If the variety or vitality of the leaves be such as to appear injured in the least by this spray, reduce the Bluestone slightly for the next spraying. Repeat this in two weeks and again in a month from the time of the first Bordeaux Mixture spray, as for fungous diseases of other plants. If the boiled Lime-

sulphur Spraying be thoroughly done before the buds burst, no other treatment will be necessary for Peach Leaf Curl that season, as the disease will not appear.

San Jose Scale: See discussion under "Apple." For Peach and Plum the oil sprays especially are to be avoided, and the boiled Lime-sulphur Washes are particularly recommended.

Yellows: This is the worst enemy of the peach and plum with which we must contend. There is a law against keeping trees infected with it, and this should be enforced. It is readily contagious and no remedy is known for it. The first evidence is shown in prematurely ripening fruits, through which streaks of red may be seen. The next stage shows in the leaves as smaller yellowish leaves, and next as small tufts of twigs, bearing yellowish diminutive leaves, and later and finally as great bunches of fine twigs with only very small yellow leaves, no fruit, and dying trees. Pull and burn trees as soon as they can be found infected and avoid dragging them through the orchard in such a way that any part will remain there or come in contact with healthy trees. Also do not leave infected trees or stumps in peach orchards that are to be cultivated, lest portions of twigs or roots should be carried by the harrow or cultivator and infect other trees.

PEAR.

Borers: The Borers of the pear trees are the Round-headed and Flat-headed borers of apple. See descriptions under "Apple."

Blight: Pear blight, Fire blight, Twig blight, Trunk blight, Body blight and Black blight are different names for the same disease. It causes the leaves to turn black and remain dry upon the branches. Blighted twigs turn dark and shrivel and the blighted spots on the bark are conspicuous by appearing dead, dry and shrunken. Pear blight is due to a bacterial disease. It is carried from tree to tree by birds, insects and other means, such as apparatus and pruning knife. To prevent this in trimming trees with the Blight the knife blade should be sterilized occasionally by dipping it into Bordeaux mixture, or a solution of Lime-sulphur wash, or turpentine. Do this frequently while pruning the trees or before passing from branch to branch. Since the blight is a disease under the bark it cannot be reached by any spray. There is no remedy known for it. A preventive is to cut off and burn the blighted branches as soon as they are seen and cut out and burn the blighted parts. Wash the cut surface with paint, boiled Lime-sulphur wash or tur-

pentine as a disinfectant. Be sure to cut the branches at least a foot below the diseased spot. Do not cultivate blighting trees, and retard the growth of the tree by not using manure or nitrogen fertilizer, as the blight is less on trees that grow slowly. Do not plant pear trees in rich or damp soil where they will have rapid growth.

Leaf Blight, Fruit Spot or Fruit Crack: These are different names for the same disease. The description and discussion is found on page 52.

Leaf Mite, or Pear Leaf Blister Mite: This mite causes brown blisters in the leaves of the pear and apple and also affects the fruit. Leaves that have spots looking like brown downy blotches on the under side should be sent to us in order that we may examine them and locate the regions where this pest is to be found. This was illustrated in our Bulletin August 1, 1907, Plate XIV. Burn the fallen leaves and apply the remedies mentioned on page 52.

Pear Psylla: The Pyslla is called the jumping plant louse because it is very much like a gray plant louse, but also jumps and flies. It looks very much like a small Cicada, and was described and illustrated in our Bulletin on the Homoptera. As it is a suctorial insect it does not eat the tissues of the plant, but injures the leaves by piercing them, injecting a poisonous saliva and sucking the sap. It is specially liable to be seen on the fruit stems and the leaf petioles or stem. The adult passes the winter in the mature or winged stage on the trunks of the trees under the scales of bark. The young are wingless and are similar in appearance to plant lice. They are to be destroyed by the remedies advocated for plant lice. This is discussed in our June Bulletin, page 51.

San Jose Scale: Described and discussed under "Apple." The same treatment is recommended for pear, excepting that pure crude petroleum can be used on pear without disastrous results which may result on other trees. Fifty per cent. mixture of petroleum will kill the scale without apparently damaging the pear trees. However, on this, the hardiest of our fruit trees, and especially on all more delicate fruit trees we recommend the home-made Lime-sulphur Wash or the Commercial solution such as the Niagara spray, made at Middleport, N. Y., and ready to be diluted with water and sprayed without straining.

Scab: See the description and treatment of Apple scab.

Slug: See description of slugs on cherry leaves. While the species is different the remedies are identical.

PLUM.

Black Knot: The Black Knot is a fungous disease of the plum and sour cherry which causes small or larger black knots on the branches. It may become so abundant on the trees as to result in their destruction. The knots deform the branches and cause loss of vitality and no fruit. Cut out and burn. See description and remedies on page 52.

Borers: The description and treatment are the same as for borers in peach.

Brown Rot or Ripe Rot: The description and remedies are the same as for this disease in Peach.

Curculios: There are two species of curculio attacking the plum. One is larger than the other, but their effects, habits and remedies are practically the same. Curculios also attack the apple, peach, cherry and quince and sometimes other fruit. They are snout beetles, mostly about ¼ inch long, and of a dark brown or gray color. They closely resemble the color of the bark of the tree, and are rarely to be seen except by spreading a cloth beneath the trees and shaking the branches, from which the beetles will fall. In the spring of the year they come from the ground, where they have passed the winter and commence to feed on the leaves and young fruit. Shortly after the blossoms fall they cut a crescent or small segment of a circle in the skin of the fruit, and when they are ready to deposit their eggs they put these through small holes made in the skin within the curve of the crescent-shaped cut. As these eggs hatch the larvæ bore into the fruit and devour it near the seed, causing the familiar "wormy" fruit. Their presence can be detected by the crescent cut, and by the hole put through the flap of such cut. The remedies are discussed on page 53 of the June Bulletin, 1907.

Lecanium or Plum Scale: A common scale of plum and peach is known by the different names, Turtle Shell, Terrapin Scale, and Lecanium. There are several species of Lecanium, but the appearance, habits and remedies are practically the same. They are almost exactly hemispherical in shape, being conspicuously raised lumps or elevations sometimes reaching a size equal to about the half of a small cherry seed. The young or undeveloped scales are to be found on the branches in the winter time, while the larger or fully developed females are to be seen during the summer. They are the largest scale insects to be found on any of our trees, and are easily recognized. They should be treated by remedies discussed on page 52 of this volume.

Leaf Blight, Shot-hole Fungus, etc.: There are many different fungus diseases that may attack fruit trees. The Shot-hole fungus

is one that receives its name from the fact that it makes holes in the leaves of the trees, very much as though they had been perforated by shot. All leaf diseases should be treated by Bordeaux mixture, or some other fungicide, as discussed on page 8 and 53.

POTATOES.

The Colorado Potato Beetle: The Colorada potato beetle is a large striped beetle which was introduced into this State about 1872, and occasionally becomes abundant and destructive in the potato fields. Its young are the familiar red and black larvæ seen on the stalks and leaves, while its eggs are deposited in the form of long slender yellow eggs arranged in an orange-colored mass. When these reach full growth they go into the ground and pupate and remain in such place during the winter. The potato beetles have many enemies, among which are their internal parasites, birds and poultry. It is the parasites which have caused them to drop out of sight occasionally and at other times to appear in greater numbers through the reduction of the parasites. There is no longer any trouble in preventing loss from the potato beetle. Spray with any Arsenical poison whenever the insects are seen. Arsenate of Lead and Paris Green are standards, with preference for the former because it sticks better.

Blister Beetle or "Old Fashioned Potato Beetle": The Blister beetles are very long, slender, dark brown or striped beetles, running quickly and reaching a length of fully an inch. Some of them are striped and some are plain black, gray or brown in color. The larvæ live in the soil feeding on soft insects which they are able to capture, and on the eggs of such insects as grasshoppers, and thus in this stage they do a great deal of good. The adults may feed on the leaves of almost any plant of the Nightshade Family. When they are so numerous as to demand suppression, effective work can be done by putting straw in rows between the vines and whipping the beetles into this with bunches of long switches, and setting the straw on fire. Those that are not burned will run or fly away.

Flea Beetles: While not the same species as the Flea Beetle of the Grape, they are similar in appearance, and the treatment is about the same. The Flea Beetles of the potato may be of two or three species, and are often so numerous as to cause the leaves to appear brown, as with blight. They feed upon the upper surface of the leaves, gnawing through to the under side but not eating through it, thus causing a number of little brown specks through which it is

possible for the germs of disease to enter. Spraying with Bordeaux mixture, with an arsenical poison added, gives good results as preventive, repellant and remedy.

Grub Worm or White Grub: See discussion of this subject under Lawn pests.

Potato Rot: This condition is generally due to a disease known as late blight, or to certain climatic conditions such as hard rains and hot weather just before the ripening time. Mud packed firmly into the eyes, which are buds, smother them and may cause rot to ensue. This can not well be prevented, but the potatoes should be lifted and dried as soon as possible, kept cool, and stored in a cool dry place. Air-slaked lime can be put over them to absorb the extra moisture. They should be carefully sorted before storing to prevent the decayed tubers coming into contact with others. The regular Potato Rot, which comes only from the Late Blight, is simply the result of the disease germs working down the stem and into the tuber. To prevent it, spray as for preventing blight, and should the blight come now pull the vines and burn before the germ works down the stem.

Early Blight: This is a blight of the leaf which may come during June which causes the leaves to turn brown and die, but which does not result in the rotting of the tuber as it doesn't strike down the stem to that part. The remedy is discussed on page 54 of this volume (June, 1907).

Late Blight: This is a disease of the leaf and stem which causes them to turn black in July or August. A germ causes this condition, and also works down the stem into the tuber, finally causing rot. It is to be prevented by spraying with Bordeaux Mixture during the early part of July, and continuing until the end of the growing season, spraying at least once every two weeks, and repeating whenever the material is washed off by hard rains.

Mildew: The appearance and remedies are similar to the Mildew of Beans.

Scab: This is a fungous disease of the tuber which causes scabby spots to appear on the potatoes. This often looks as though it were done by a worm having taken a bite or two, here and there, over the tuber, and they are sometimes wrongly called "bug-eaten" tubers or potatoes. This condition is caused in one of three ways:

(a) Planting scabby seed potatoes;

(b) Planting potatoes in soil that is already infected;

(c) Using as a fertilizer stable manure which contains the germs of the Scab.

To prevent it potatoes should not be planted in ground where scabby potatoes had previously been grown, and all seed potatoes

should be soaked in Corrosive Sublimate or Formalin. We much prefer the Formalin and find it effective and satisfactory. Use one pint of Formalin in 15 gallons of water and soak the potatoes from 40 minutes to one hour. In our practical planting we have a series of barrels, one above the other, at such elevations that the liquid will run from one to another. It can be used over and over again as long as any of it is left.

Stalk Borer: The potato Stalk Borer is a serious pest, as it is an insect that feeds inside the stalks or vines. In fact, there are two species, one of which is the larva of a moth, reaching a length of nearly an inch, and being striped with light pink or white stripes extending lengthwise. The other is the larva of a Snout Beetle likewise boring in the stalk or vine. Their appearance is to be detected by the sickly or yellowish appearance of the leaves and vines. These vines should be cut, or pulled, and burned as soon as it is found they are infested. As these borers also infest the stalks of large weeds it is very important to keep the weeds well cleaned up around the premises where potatoes are planted. In the fall just as soon as the potatoes are raised, the vines should be gathered and burned. Where there have been many stalk borers at work the ground should be plowed and cultivated in the fall and cultivated again, with a spring tooth harrow as early as possible in spring, and again before planting.

QUINCE.

Borers: Same description and treatment as for borers of Apple.
Codling Moth: Same description and treatment as for Apple.
Curculio: Description and treatment given under Plum Curculio.
Blight: Description and treatment given under Pear.

ROSE.

Aphis or Plant Lice: See description and treatment of Aphis under Apple.

Black Spot: This is a fungous disease of the leaves which causes them to appear black in spots. It is to be prevented by occasionally spraying with a fungicide. Cupram is to be recommended for the reason that it is colorless and does not stain the leaves.

Leaf Hoppers: Description and treatment similar to those of Leaf Hoppers of Grape.

Rose Bug: See description and treatment under Grape.

Mildew: See description and treatment under Bean.

Red Spider: The Red Spider or Red Mite is not an insect but is really a kind of spider. In its structure it is in accord with the spiders rather than the insects. It is to be killed and prevented by spraying with something that contains sulphur. Sulphur is almost a specific or certain remedy for this particular pest. Where forceful jets of water can be used, as from a force pump or hydrant, it is well to wash or syringe the plants with water, and spray with Potasium Sulphide or Soda Sulphide, two ounces of either, dissolved in a gallon of water, or dust with sulphur while the leaves are damp, or spray with eight per cent. Kerosene Emulsion, with a handful of flowers of sulphur added, or with a soap solution and water, with sulphur added to the same.

Rust: The rust of roses, berry bushes and other plants is caused by a fungous disease making the leaves look red and rusty in appearance. Sometimes they appear quite red. It is to be treated by abundant spraying with Bordeaux and picking the diseased leaves and burning them. As fast as the individual leaves show the rust they should be picked and burned. Destroy all fallen diseased leaves. It is possible to spray with Cupram which is a colorless liquid and does not make a stain. Make the spraying as soon as the leaves open and once every two weeks after.

STRAWBERRIES.

Aphis or Plant Lice on the Roots: The root aphids which live in the soil, are often white in color, but sometimes they are greenish and sometimes bluish, and sometimes dark. If the strawberry plants are not doing well the roots should be examined for pests. If the aphids or plant lice be found present, fumigate by putting Carbon Bisulphide in holes in the soil around the roots, or mixing tobacco dust abundantly in the soil near them, or remove the plants from the soil entirely and fumigate with Hydro-cyanic acid gas, one ounce of Cyanide to 1,000 cubic feet of space, the same as for Greenhouse fumigation. The best plan is to be sure to set clean or uninfested plants in soil which did not grow strawberry or melon plants during the previous year. If it be impracticable to fumigate the plants before setting them out, dip the roots into a strong tobacco decoction or eight per cent. Kerosene Emulsion. Where strawberry vines are badly infested they should be plowed under and not replanted on that plot for at least one year. This soil can be planted in other crops, excepting melons.

Cut Worms: See description and discussion of Cut Worms under Corn.

Leaf Roller: This is a small insect larva which develops into a very small winged moth. The destruction is caused by the larva rolling the leaf into a tube, within which it lives, feeding on the foliage. The best remedy is to burn the leaves, the same as for leaf blight, as soon as the fruit is gathered.

Strawberry Leaf Blight: This is a fungus disease of strawberry leaves which causes them to blight and cause injury to the strength and vigor and fruitfulness of the plants. It is to be prevented by spraying before the blossoms come, with Bordeaux Mixture, and especially by mowing the leaves as soon as possible after the fruit is gathered, and drying them like hay in the sun, enough to be able to rake them together between the rows and burn them. This is a good treatment for all strawberry beds. If the leaves will not readily burn, put them on rows of straw placed between rows of plants. Burn when the wind will carry the fire lengthwise of the rows of straw and dry leaves.

Saw Fly: The description and remedy are similar to that of the Saw Fly on Currant.

Weevil: The strawberry Weevil is a snout beetle which punctures the fruit stalk. While no good remedy is known, it will be effective to pick off and burn the drooping vines or fruit stalks as soon as they are seen. Where it appears in a strawberry field it is advisable to avoid those plants that are purely staminate, or are "fertilizers," bearing no fruit.

TOBACCO.

Flea Beetle: See description and remedies under Grape.

Grass Hoppers: These insects are too familiar to need a lengthy description. They injure the leaves by eating holes in them, especially near grass fields. They are to be destroyed by arsenical sprays or by keeping turkeys to roam over the fields to feed on the grass hoppers.

Tobacco Worms: The chief Tobacco Worms are those that have a caudal spinal horn, and reach a large size, being nearly as large as a man's finger. The larva goes into the soil and transforms into a chrysalis with a long curved handle, which is really a sheath in which the mouth parts are contained. In this state they pass the winter in the ground, and come forth the next spring as quickly flying moths, that are to be seen in the evenings near tubular flowers, looking like humming birds, and are called "humming bird or hawk

moths." These in turn lay eggs on the tobacco, tomato and potato, and other plants of their botanical family, and from these the "worm" or larva hatches. They should be picked off by hand, or sprayed with an Arsenical poison while the plants are young. Paris Green spraying is now common and successful for these.

Tobacco Seed-Pod Worm: This insect is a moth of a beautiful mottled green color, wings nearly one inch in expanse, which has lately come into this State from the South. The eggs are laid in the summer on the seed capsules, and the larvæ bore into the capsules and feed on the numerous seeds, thus destroying the seeds that might be saved for planting. Whenever they are found they should be picked off and burned or crushed. If there is much infestation the entire tops should be cut off and burned and seed procured elsewhere rather than continue to run the risk of destruction by this pest, by growing seed pods for it to infest that year.

TOMATO.

Cut Worm: See description under Corn.
Tomato Fruit Worm or Boll Worm: See description under Corn.
Flea Beetle: See description of Flea Beetle under Grape.
Totato Worm: See Tobacco Worm.

WHEAT.

Hessian Fly: The damage is done by this insect in the fall or spring, when it is in its larval stage. It is the larva of a small fly which in a great portion of this state has two broods per year. The eggs are laid generally during the last week in August and the first three weeks in September. To avoid this loss, wheat planting should be delayed until after the 20th of September, and in the southern and southeastern portions of the State it should be even later.

The Hessian fly in its larval stage is a white maggot, feeding beneath the sheath of the leaf at the base of the stalk, sucking the juice of the plant, and resulting in its death, or stunting the growth of the plant and causing it, at that time, to have a bushy appearance. Such plants may not survive the winter. Description and remedies are given on page 56.

Smut: Smut is a fungous disease causing black heads of wheat and oats, and considerable loss. It can be prevented without any trouble by treating the seed before planting, by soaking one-half

hour in a solution of Formalin or Corrosive Sublimate, the same as recommended for treating potatoes before planting.

Wheat Head Army Worm: This is a dark, somewhat striped insect larva which reaches a length of about one inch, and may march as an army if it becomes sufficiently numerous to destroy all its food, which causes it to march by reason of hunger, or it may remain in a field and damage the wheat heads at the time they reach the milky stage. Remedies are given on page 56.

Persons not having a copy of the June Bulletin frequently cited above, can obtain it by writing for the same, to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

AVOID CARBOLIC ACID TREATMENT.

During the months of March and April of this year an article was extensively circulated in some of the newspapers to the effect that Carbolic Acid could be used against scale insects and other pests of trees. This has caused so much trouble that we have been obliged to write many letters concerning it, and in order to set forth the facts of the case that the public may read and understand, we publish below the article and also our correspondence with a nurseryman and Dr. J. B. Smith, State Entomologist of New Jersey, upon this subject. We think this should be enough to convince readers that the Carbolic Acid treatment is not to be relied upon.

"CARBOLIC ACID USED TO FIGHT TREE PEST."

Montgomery County Farmers Interested in Experiments of Philadelphia Judge.

Results Encouraging.

North Wales, Pa., March 15.

Farmers interested in preserving their trees from the ravages of the San José Scale are watching with considerable interest the experiments with carbolic acid that are being conducted at several places in Gwynedd township, Montgomery county.

The havoc wrought by the scale is such that in some sections many of the fine old shade trees and orchards surrounding the residences of wealthy Philadelphians are in danger of complete destruction. The labor and time necessary to thoroughly spray a large number

of trees is quite an item to the busy farmer, but many believe that through the acid treatment there is a way of completely destroying the pest at a very slight cost.

Judge William H. Staake, of Philadelphia, whose summer residence and farm are situated near the Friends' Meeting House, Gwynedd, is the first one here to use a 25 to 30 per cent. solution of carbolic acid in his fight against the scale. Judge Staake has sent to a local paper the result of the experiences of a friend near Lambertville, N. J., where the acid has been used for several years with such good effect that the scale has disappeared entirely from every tree on the place.

The acid was first applied by painting a band about eighteen inches wide around the trunk of all the trees, and practically all the scale was killed. The next year the trees were painted from the ground up to the limbs with a 50 to 60 per cent. solution of second quality carbolic acid, and the scale disappeared entirely, and that year over 4,000 bushels of fine apples were gathered from a sixteen-acre orchard, which the year before had borne no crop worth speaking of.

The experiments have shown that the best time to apply the acid is when the sap is running, as the sap neutralizes the effect of the acid. The rough bark is first scraped off and the acid applied with a paint brush from the ground up to the limbs, and, if the scale is very bad, up the limbs of the trees as far as possible. The same treatment has been applied to berry bushes of all kinds with good results.

The following is a letter I received from a nurseryman in Pennsylvania:

Hoyt, Pa., March 16, 1908.

Mr. H. A. Surface, Harrisburg, Pa:

Dear Sir:—I am enclosing letter sent to Judge S——— and later turned over to Mr. C. F. G———, of Hoyt. Mr. G——— mailed the letter to me and asked me what I thought of the same. There are several persons in this section, friends of Judge S———, that have already purchased the Carbolic Acid, as I saw two shipments at the depot this morning. I would like to have your opinion of same and expect to try it on two trees badly infested with scale on the G——'s place. If it is as good as Mr. T——— says, it will be a good thing for everybody to know. An early reply will be greatly appreciated.

Yours truly,

F. S.

The following is our reply to the above letter:

March 17, 1908.

Mr. F. S., Hoyt, Pa.:

My dear Mr. S.:—Replying to your letter of the 16th, asking about the use of 50 per cent. Carbolic Acid painted on trees from the ground to the lower limbs for scale insects, I beg to say that this is to be a re-hatching of an old and exploded notion. It is a very decided error. There is no doubt in my mind of the certainty or truth of this statement. In the first place, such material painted on the bark will not be taken up in the sap, and in the second place if it should be so absorbed and carried up into the trees, anything that would be strong enough to kill the scale and other insects, would also kill the tree, and its application would thus be worse than useless. The great difficulty appears to be that persons who have trees do not know for certain when the scale is dead and when it is not, and they pronounce in favor of it when they really do not know the evil results for themselves. I would by no means recommend the use of such a thing as Carbolic Acid either as a spray or wash for scale insects. There is nothing known that will kill the pests on the branches of trees without coming into actual contact or touch with them. If the Acid of the strength advocated come into contact with the buds, it might kill them.

The more I see in this State and the more reports I receive from my inspectors in the various parts of the State, the more fully am I convinced that there is nothing to equal the Lime-sulfur Wash as an effective and cheap insecticide for the scale and other insect pests, and also as a fungicide. I have hundreds of letters to testify to this important fact. If you do not wish to go to the trouble of making the boiled Lime-sulfur Wash, you can use the commercial material, if you will buy the right kind. I have tested the Niagara Lime-sulfur Spray, made by the Niagara Spray Co., of Middleport, N. Y., and have found it to give excellent results. This is sold by the barrel in a concentrated form and can be diluted with ten or twelve times the amount of water and will act as a fungicide and insecticide, when merely dilute with cold water. This is to be recommended as it is a most satisfactory commercial insecticide in case you do not wish to make the home-boiled Lime-sulfur Wash. I would advise that you try some on your trees beside those on which you try the Carbolic Acid treatment. Do a thorough job with each material and note the results in a year or two from now. The letter to Judge S——— is herewith returned.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

DENIAL OF CARBOLIC ACID TREATMENT FOR SCALE.

The following is our correspondence with Dr. John B. Smith, State Entomologist of New Jersey, on this subject:

March 17, 1908.

Dr. J. B. Smith,
New Brunswick, N. J.

My dear Doctor Smith: I have a letter from a man in Philadelphia concerning a trip that he took to the farm of Mr. Thatcher, some distance above Flemington, N. J., for the purpose of seeing the results of painting various trees and bushes near the ground, with a thirty per cent. aqueous solution of carbolic acid for the San José Scale. He claims that he has cleaned the trees of bad infestation, and adds "The New Jersey State Experiment Station has been making an investigation; the first year they laughed at the idea and its folly, last year they had men there nearly the whole year, and the Chief of the Bureau stated that he took off his hat and bowed to the success of Mr. Thatcher's treatment, and this recommends it for general use as the only method to combat the pest."

I write to ask if you will kindly give me information concerning this. I had heard of the proposed carbolic acid treatment, but have not learned that you so fully endorsed it. I shall thank you for light on an interesting subject.

Very truly yours,

H. A. SURFACE.

Prof. H. A. Surface,
Dept. of Agric.,
Harrisburg, Pa.

New Brunswick, N. J., March 19, 1908.

Dear Prof. Surface:—Yours of the 17th inst., is at hand. I have seen that letter and it is a mass of misstatements from one end of it to the other. Some reference to the work done by Mr. Thatcher is in my Report for 1906, which of course you have, and a more full report of what was done and what inspections were made appears in the Report for 1907, which is just off the press, and a copy of which I am sending you, under separate cover, by same mail. A number of people who have used this carbolic acid banding claim success for it; but in almost every instance there is an explanation other than the banding for the comparative freedom of trees from

scale and nothing is further from the truth than the statement that there were no live scales on Mr. Thatcher's apple trees.

Very truly yours,

JOHN B. SMITH.

March 23, 1908.

Dr. John B. Smith,
New Jersey Agricultural Experiment Station,
New Brunswick, N. J.

Dear Doctor Smith: I desire to thank you for your favor of the 19th, giving me information that the article on the use of Carbolic Acid for Tree Pests is a fake and a mass of misstatements. By this morning's mail I have received no less than five or six letters containing the enclosed clipping, and asking me about it. It evidently will do much damage in this State and New Jersey by inducing the people to use it instead of a spray of proper material for the scale. I, of course, did not believe the statements there made, but when they plainly brought out your name in the article, I thought there might be something that we had not previously realized.

Very truly yours,

H. A. SURFACE.

Prof. H. A. Surface,
Dept. of Agric.,
Harrisburg, Pa.

New Brunswick, N. J., March 24, 1908.

Dear Prof. Surface:—Yours of the 23rd inst., with inclosure is at hand. This thing is making me a lot of trouble, and I suppose will continue to do so for some time to come until the newspaper articles are forgotten. I have not attempted to reply and will not, because that would only keep the subject alive. This carbolic acid thing is one that must run its course, and it will take two or three years before it completely dies out.

Very truly yours,

JOHN B. SMITH.

COMMERCIAL SPRAYERS.

The following is a list of names and addresses of persons who will furnish apparatus and do commercial spraying. If others are known we shall be glad to learn of them.

Bedford County.

Mr. Todder, Bedford.
Mr. L. O. Walter, New Enterprise, Pa.

Berks County.

Mr. Henry Miller, Shoemakersville, Pa.
Mr. W. P. Ruth, Sinking Springs, Pa.
Mr. J. S. A. Schaeffer, North Heidelberg, Pa.
Mr. J. H. Giles, 123 S. Fifth St., Reading, Pa.
Mr. W. K. Hummelreich, Blandon, Pa.
The Board of Poor Directors at Shillington have a Niagara outfit which they will rent.

Blair County.

Mr. N. A. Rhodes, Tyrone, Pa.

Bucks County.

Mr. H. L. Shelly, Quakertown, Pa. (50c per tree).
Mr. Jos. T. Diehl, Perkasie, Pa. R. No. 2.
Mr. E. H. Alderfer, Souderton, Pa. Bell 19W. 2 machines.
Mr. Charles Rickert, Perkasie, Pa.

Chester County.

Mr. Dennis Gallafher, Strafford, Pa.
Mr. J. D. Thomas, Whitford, Pa.
Mr. Chas. S. Coates, Nottingham, Pa.
Mr. J. T. Clarke, West Chester, Pa.

Clinton County.

Mr. H. S. Bollinger, Lock Haven, Pa.

Cumberland County.

Mr. John Hale, New Cumberland, Pa.
Mr. Kast, Mechanicsburg, Pa.

Dauphin County.

Mr. J. R. Snavely, Harrisburg, Pa.
Mr. E. B. Mitchell, Harrisburg, Pa.
Mr. Roy P. Walter, Berrysburg, Pa.

Lackawanna County.

Mr. Clark, (Florist), Scranton, Pa.

Lancaster County.

Mr. Jacob Chambers, Lancaster, Pa. Care of Dr. S. T. Davis.
Mr. D. P. Bricker, Lititz, Pa.
Mr. A. F. Trout, Quarryville, Pa.
Mr. C. D. Herr, Cresswell, Pa.
Mr. G. B. O. Felty, Millersville, Pa.
Mr. B. F. Barr, Lancaster, Pa.
Mr. J. Wilmuth, 735 E. Orange St., Lancaster, Pa.
Mr. Menno E. Shirk, Stevens, Pa.
Mr. Moses Lapp, Gap, R. F. D. No. 2.
Mr. Harlan Gatchell, Peters Creek, Pa., R. F. D.
Mr. E. Eshleman, West Willow, Pa. R. No. 2.
Mr John H. Weaver, New Holland, Pa., R. F. D.
Mr. John Kensinger, Leola, Pa.
Mr. Wesley Brook Hart, Lititz, Pa.
Mr. John Reist, Mt. Joy, Pa.
Mr. Phares Martin, Reidenbaugh's Store, Pa.

Lycoming County.

Mr. Wolf, Williamsport, Pa.
Mr. Hamilton, Williamsport, Pa.

Monroe County.

Mr. Randall Bisbing, E. Stroudsburg, Pa.

Montgomery County.

Mr. D. M. Ellis, Bridgeport, Pa.
Mr. H. E. Wohlert, Bala., Pa.
Mr. John M. Markley, Lansdale, Pa., L. B. 245.
Mr. J. K. Schwenk, Providence Square, Pa.
Mr. W. E. Baker, Skippack, Pa.
Mr. Calvin Hart, Lafayette Hill, Pa.
Mr. C. K. Milford, 1041 Green St., Norristown, Pa.

Mr. John Mooney, Conshohocken, Pa.
Mr. G. L. Oddy, Centre Square, Pa.
Mr. Wm. Sturzwecher, Lansdale, Pa.
Mr. Peter Reilly, Rosemont, Pa.

Northampton County.

Mr. L. E. Graver, Easton, Pa., R. No. 1.
Mr. J. N. Hartzell, E. Bangor, R. F. D. No. 43, Pa.
Mr. Ervin S. Lambert, Easton, Pa., R. No. 4.

Northumberland County.

Mr. F. A. Newcomer, Milton, Pa.

Philadelphia County.

Mr. Herbert Inman, 2419 N. College Ave., Phila., Pa.

Schuylkill County.

Mr. Al. Kimmel, Orwigsburg, Pa.
Mr. J. L. Heine, Orwigsburg, Pa.
Chas. Diehl, Pottsgrove, Pa., R. F. D.

Snyder County.

Mr. W. H. Bingaman, Beavertown, Pa.
Mr. J. J. Tobias, Beavertown, Pa.

Union County.

Mr. H. A. Taylor, Mifflinburg, Pa.
Mr. Geo. Kunkel, Lewisburg, R. No. 1, Pa.

York County.

Mr. John O. Gardner, 25 E. King St., York, Pa.
Mr. Marion Thomas, Delta, Pa.
Mr. Howard Anderson, Stewartstown, Pa.
Mr. John H. Baird, Stewartstown, Pa., R, No. 1.
Mr. W. H. Gemmill, Woodbine, Pa., R. No. 3.
Mr. John F. Stern, Sunnyburn, Pa.
Mr. John H. Budd, York, Pa.
Mr. D. Barnett, Woodbine, Pa., R. F. D.
Mr. O. K. Burkins, Woodbine, Pa., R. F. D.

COMMERCIAL AND NEW INSECTICIDES.

At this time of year we are receiving so many inquiries concerning new insecticides and commercial preparations that we deem it our duty to give general information, and at the same time reduce our personal correspondence on these subjects by publishing a few words concerning them.

The homemade soluble oil has not proven as satisfactory as circulated reports indicated it to have been. We know not how the report became so extensively circulated to the effect that we were pleased with the results of the homemade soluble oil. The statement was that it was apparently as good as any of the commercial or soluble oils on the market, but this is not saying a great deal for it. However, if contrary to all recommendations and warnings from this office and the experience of numerous practical fruit growers, whom we can name, persons should yet insist on using the so-called soluble oil (either commercial or home-made), in preference to the more satisfactory and better Lime-sulfur Solution, they can make the oil for themselves according to the directions published in our March Bulletin, at less than half the cost of the commercial oils, which may have about the same virtue.

Regardless of what may be said by agents and manufacturers, the commercial oils do not contain fungicidal properties, and they are not of uniform composition. There is liable to be injury of serious nature resulting to the trees from their use. We have before us written communications from various persons whose trees have been killed by them. The chief preparation for censure and criticism, according to our observations and extensive correspondence, is the one sold under the name of "Target Brand" or "Target Brand Scale Destroyer." From the evidence now at hand, we feel it our duty to warn our citizens against depending upon this material. We have before us a letter from a man, stating that the makers of this stuff paid him five hundred dollars ($500.00) in payment for trees which he had killed with it, and from another man stating that it had been so disastrous in his region that the Company recognized its evil results and were so generous as to withdraw the claim for payment of the material that had resulted in the destruction of the trees, and from another person to the effect that fruit trees of different kinds in his large orchard had been killed by it, and he now is collecting evidence and material for a suit for payment for his trees by the Company, but the latter refuse this, further than to offer him

the original cost, which is only a few cents each, for fine bearing trees that were just coming into their prime when sprayed and killed by "Target Brand." We know where commercial sprayers have used this material, with such results that they have lost their patronage, and the trees remain badly infested with scale, or show signs of injury by the material. Such positive reports and results of personal observations are the basis of our statement that we should not use the "Target Brand" on trees that we wished to save, even though the material were donated and the freight charges paid.

The oil preparation next in line for complaint is the one sold as "Scalecide." We have seen many trees in the most deplorable condition from its use. It proves the truth of our statement that the danger line between killing the tree and failing to kill the insects is so close or narrow that we can not hope to keep within it by the use of oils. We have letters now before us, reporting very disastrous or unsatisfactory results from the use of this material, and in one county of this State, where it has been advertised and used most extensively, the agents themselves are acknowledging that it has proven unsuccessful in controlling the scale. We know one large Pennsylvania fruit grower, who is an agent for this material, who has taken the opportunity at Farmers' Institutes, where he was a speaker, to advertise it extensively; but at the same time, we know from personal examination that his orchard is most seriously infested with San José Scale, and annually is becoming worse instead of better, although he has been using this material. He does not appear to know or to recognize the actual results and their cause. If fruit growers will watch carefully, they will see that most of the recommendations of the soluble oils come from persons who are interested in returns from their sales.

Our inspectors are going through the State in a thorough manner, and they report to us that far more Lime-sulfur Wash is being used in spraying for scale insects than any other material, and in fact more than all other materials combined. Their reports also show that this is the material which is giving the most uniform satisfaction. The following letter to the Economic Zoologist, from Dr. J. D. Herr, one of our careful and capable inspectors, explains the situation concerning Commercial Oils and the Lime-sulphur Wash in Pennsylvania:

"These Adams county orchardists are gentlemen. They also appreciate our work and endorse your methods. In fact, you have many friends among them. I find that the only good results of spraying so far found here have been gotten from the use of the Lime-sulfur Wash. Many who have used 'Scalecide' are becoming

disgusted with it and will use Lime-sulfur this spring. Mr. B's experience, as he expressed it to me, is typical. 'After trying everything I got down to the Lime-sulfur Spray, which is the only thing that did any good, and I had a fine crop of clean apples last fall.' I know this reads like a testimonial of a patent medicine, but an examination of his orchards proved the truth of his words."

Likewise the orchard on Mr. Ds' farm. This eight acre orchard has been sprayed for years with Crude Petroleum, Target Brand and Scaleside and a worse infested orchard is hard to find anywhere. Thus showing that the fight has been a losing game with oils."

The agents for oil preparations are making the claim that not more than one fruit grower in ten is using Lime-sulfur Wash, and not more than one in four of those that use it, is having success. Of course, this is the claim of an agent, and must be taken with due allowance. The fact is that a far greater percentage of successful results have been obtained by our fruit growers using Lime-sulfur Wash than by any other material, and it is with certainty destined to become the standard insecticide and fungicide for scale insects and certain other insects and certain plant diseases, such as Peach Leaf Curl, Mildew, etc. Some emphatic statements can be made for the Lime-sulfur Wash that can not be made for any of the oil preparations. Among these are the following:

1. It is the cheapest.

2. It is the most easily obtained wherever needed.

3. It is not destructive to trees, and in fact can not be used strong enough to injure the trees, bushes or vines when dormant.

4. It is a tonic and especially beneficial on some trees, such as peach and plum.

5. It is a fungicide and destroys disease germs as well as insects. One spraying, when dormant, as for scale insects, will prevent the appearance of Peach Leaf Curl during the next summer.

6. It will not be injured by freezing, as are the prepared oils.

7. It has had more extensive satisfactory use by practical fruit growers than has any other known insecticide and fungicide.

8. It is most generally or universally recommended by economic entomologists connected with the U. S. Government and with State Experiment Stations and State Departments.

The most promising sign of the times in insecticide and horticultural work is the immense number of firms very recently preparing and selling the Lime-sulfur Wash in commercial form. They appear just to be recognizing what we have published during the past five years, that this material can be made and kept until wanted and diluted and used with success. We do not understand why this has not been done before this time, but within the coming year there

will be floods of advertisements of no less than eight or ten firms preparing Commercial Lime-sulfur Washes. The explanation lies in the fact that they recognize that the oils can no longer combat in merits with the Lime-sulfur Wash, and hence they desire to put on the market that which is recognized, demanded and used, even though it come into competition with all their previously advertised materials.

It will be remembered that there was a kind of Lime-sulfur-soda Solution put on the market under the name of "Con-Sol," made by the company that is now making and selling the "Target Brand." We found it necessary to condemn "Con-Sol" for its inefficiency, and although it was very widely advertised and most extensively recommended, the manufacturers themselves in the course of time agreed with us as to its failure to meet the needs of fruit growers, and withdrew it from the market.

It is now impossible for us to attempt to answer the many inquiries as to which is the best of the numerous new Lime-sulfur Washes on the market, as we have not been able to test them all, and we would advise the public to go slow in giving extensive orders of some of those that have not been tested, or have not been used before the present season. However, one that we have tested, and recommend, and which has been used with decided satisfaction in previous seasons and other States, is the commercial Lime-sulfur Wash, known as Niagara Spray, made by the Niagara Spray Co., Middleport, N. Y. This is setam-boiled, under pressure, and is ready to add to a tank of cold water and proceed with the spraying operation, without straining or other trouble.

Another firm is now commencing to advertise a Lime-sulfur Wash, which they claim can be diluted with twenty parts of water. An analysis of this statement shows that they should have all the extracts or insecticidal and fungicidal material from at least nine pounds of Lime and six pounds of Sulfur condensed into one gallon of the liquid to dilute it this much and yet be effective. This is too evidently impossible for us once to consider any such proposition as a Lime-sulfur Wash that can be diluted with one to twenty and be effective. Fruit growers should be on their guard concerning misrepresentations, and may write us for advice on these points if they choose. We shall be pleased to give accurate and conscientious information.

COPIES OF CORRESPONDENCE.

The following letters and replies are taken verbatim from our correspondence, and are of such general interest to many readers as to justify publication in this Bulletin:

Washing Small Trees Instead of Spraying.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I have about 12 or 15 young trees (two years old), apple, cherry and plum. The apple trees are badly infested with San José Scale. It seems to me there should be some way to wash these small trees without mixing one of the formulæ which would make 100 times what would be needed. Would clear kerosene oil do?

Answer.

Replying to your inquiry of the 7th, asking if you can wash your small trees that are infested with San José Scale instead of spraying them, I beg to say that you can do so very successfully, and also at any time of year. When the trees are in leaf we can not spray with a material strong enough to kill the scale because of the danger of killing the leaves, but if we apply the Lime-Sulfur-Wash or other insecticide with a brush we can put it where it is wanted by taking care to avoid applying it to the green shoots or young leaves. Of course, it is necessary to cover all the infested twigs. but with a very small tree this can be done without great difficulty. It will surely kill the scale.

By no means should you use clear kerosene oil, as this will be practically certain to kill the trees. I must again emphasize the necessity of following the formula prescribed in bulletins upon this subject. You can use Whale Oil Soap, one pound in a gallon of water, or common laundry soap, or soft soap, two or three pounds in a gallon of water, if you keep the material off the leaves. but the standard material is, of course, the Lime-Sulfur-Wash, either home-made or the commercial article, such as the Niagara Spray, made by the Niagara Spray Co., at Middleport, N. Y. If you wish to make the Lime-Sulfur Wash for yourself, take the formula of seventeen pounds of sulfur and twenty-two pounds of lime and fifty gallons of water, and divide this by the same number. For example, if you wish only one-half gallon, which would perhaps be enough to paint two or three small trees, use 17-100 or about 1-5 lb. of sulfur, and 22-100 or slightly more than 1-5 lb. of lime and

50-100 or ½ gal. water. Boil it an hour, in an old iron kettle, or any other vessel excepting copper. In the same way, find the proportion for any larger quantity that you would wish to use. A good general formula for a small amount of the Lime-Sulfur Wash is one pound of sulfur and one pound of lime, boiled in water for one hour, and water added to make three gallons when dilute. You can, of course, in applying it with a brush, make it two or three times this strong if you desire, and you need not go to the trouble of straining it. It will not injure the trees at any strength. In this regard it differs from the oils, which should never be used stronger than our regular prescribed formula.

For trees that can be reached with brushes I recommend washing after the leaves are too far out for spraying.

Maple Scale.

Hon. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I take the liberty of sending you herewith a small branch from a maple tree infested with some parasite. This has been very prevalent on trees in town for a year or more and I would like to ask you what it is, and if it is likely to destroy the life of the trees, and what, if anything, will kill it.

If it menaces the life of the tree would the State send a competent person to spray the trees, if the owners would combine to pay the expense?

Answer.

Replying to your letter of the 2d, I beg to say that the maple branch which you sent to us was duly received and examined, and entered in our collection as No. 11,480. It proves to be infested with the Maple Turtle-shell, also sometimes called Terrapin Scale. This is one of the worst pests of maple, and is liable to result in serious injury to the tree, but fortunately it is held in check by parasites which in time develop and thrive inside the body of the scale insect and destroy it. However, it is not advisable to wait for the parasites to do their good work. If the trees be much infested, it is best to spray them as soon as possible with the boiled Lime-sulfur Wash. If you can not readily make your own material, according to the formula in our October Bulletin, I would recommend the commercial material made and sold by the Niagara Spray Co., of Middleport, N. Y. For this particular pest use it double strength, or in other words dilute one gallon of the commercial material with five gallons of water instead of ten, or dilute the

home-boiled formula (17 lbs. sulphur, 22 lbs. lime), with water to make 25 gals. after one hour's boiling. As this commercial material is liquid and needs nothing more than the addition of cold water to be prepared for spraying over the trees and kills the scale pests, and as it does not need to be strained, heated, or otherwise treated after you receive it, it appears to me that any person could spray successfully with it who would be able to procure a spray pump, and who would do a thorough job of spraying, covering the trees from all sides, from the tips of the most remote branches to the base of the trunk. If the wind be blowing they can be sprayed from one side only, and when the wind changes, or when it is calm, direct the spray from the other side.

Unfortunately, we have no person in this office who does commercial spraying. All of our men can do spraying and do this in a demonstration manner, or to show how spraying should be done, but we do not spray for pay, and we have no arrangements for this, and consequently can not undertake it. However, if some person in your region would at once get to work in this regard and let me know when you are ready to spray, I would be willing to send my nearest inspector to spend a few hours with him and get him properly started.

There is no time to lose in the treatment of this pest this spring before the buds burst, as it is practically impossible to spray successfully for it while the leaves are on the trees, and your next shot at it would be next fall as soon as the leaves drop.

How Late to Spray.

Dear Sir: Enclosed please find some peach twigs. Are the buds too far advanced to do any more spraying? I am only half done, but there is no scale on any of the trees. I use 17 lbs. sulfur, 22 lbs. lime, no salt, and 50 gallons of water.

Please let me know at once as I am waiting for a reply.

Answer.

Replying to your letter of the 3d, enclosing some peach twigs, and asking if buds are too far advanced to spray with the Lime-sulfur Wash, I beg to say they are not. It is my opinion that unless it should become very warm you can spray this spring until after the middle of April with safety, and with benefit to the trees. Perhaps you can spray even longer than that. My rule is to spray until the blossoms are just ready to open, and stop at that time. This means after the blossoms are seen but before they open.

Perhaps this may prove to be a day or two late, but I saw trees that were sprayed when in such condition of advancement, and they were not injured by the spray liquid, but the scale was killed and they bore good crops of fruit. These were peach trees, and we also sprayed both peach and apple last year when the leaves were nearly one-half inch in length, using the regular winter formula of the Lime-sulfur Wash, and killed the scale and did not injure the trees, although the tips of some of the leaves were scorched brown. I understand that you can obtain a commercial preparation sold as the Niagara Spray Solution. This is a concentrated Lime-sulfur Solution, made by the Niagara Spray Co., at Middleport, N. Y. I believe this is sold by some person in your region, and I recommend it as a good material in case you are now rushed for time and do not care to make your own Wash and need a material that must only be diluted with cold water and sprayed on the trees in a hurry without having to take the trouble of boiling or straining it. At this time of year every suggestion that will save time in doing spraying is worth many dollars to a man. I agree with you in the idea of spraying peach trees and also plum trees with the Lime-sulfur Wash whether they have scale or not. I have carefully examined your twigs for scale and find none upon them.

A CORRECTION.

On page 347 of the March Bulletin, Vol. V, No. 11, the Lime-sulfur formula was published as 22 lbs. lime and 17 of sulfur. These numbers should be reversed as a little more lime is recommended than sulfur, but satisfactory results would be obtained by using the formula as there given. The only objection would be a little increased cost by the use of sulfur than the less amount of lime would demand.

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